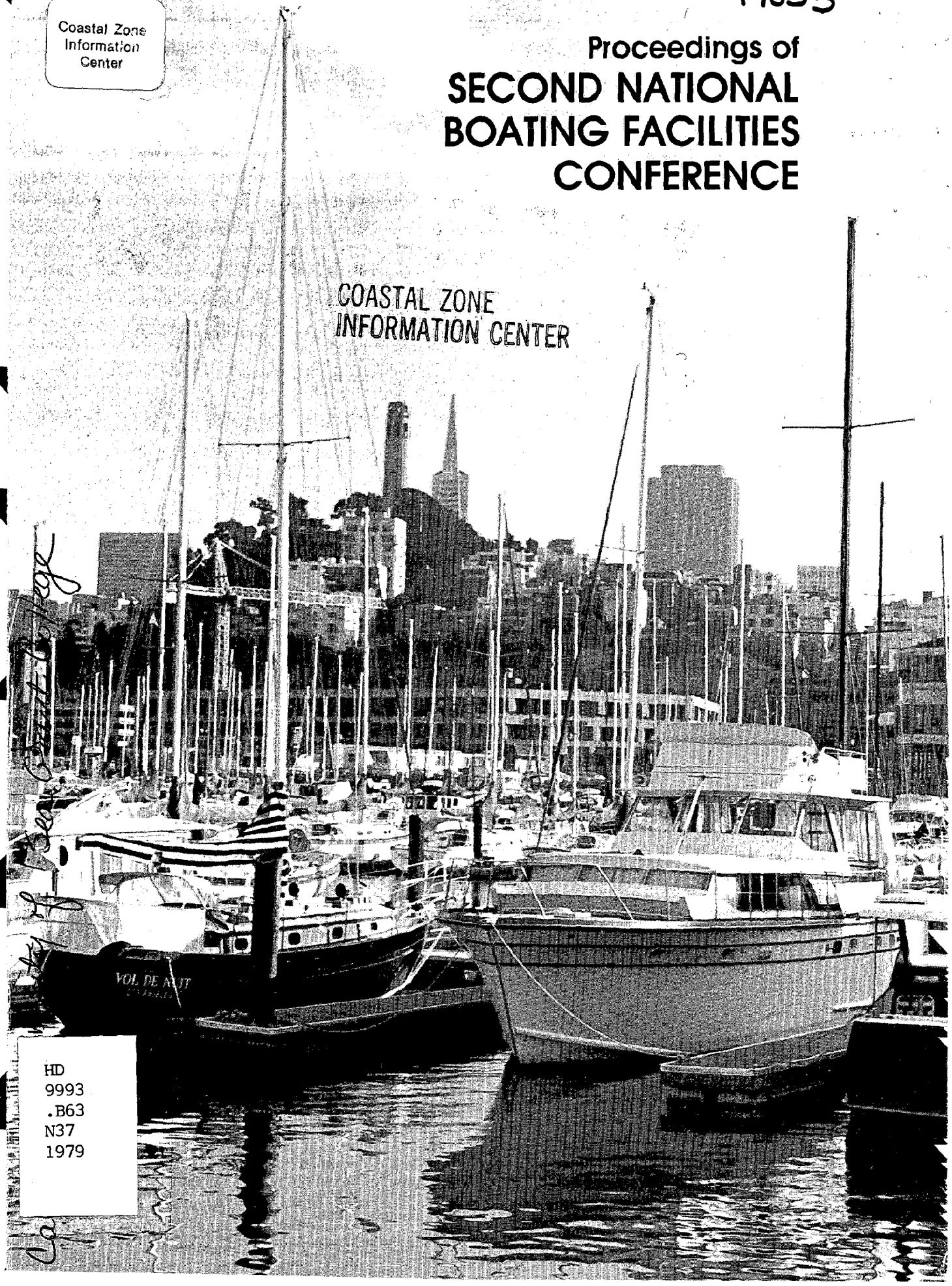
Proceedings of SECOND NATIONAL BOATING FACILITIES CONFERENCE



PROCEEDINGS OF

SECOND NATIONAL BOATING FACILITIES CONFERENCE

Berkeley Marriott Inn
Berkeley, California
October 22-24, 1979

Edited by

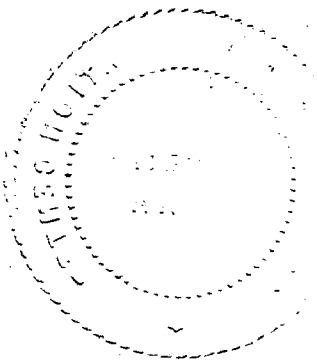
Andrew T. Manus

Sponsored by

National Marine Manufacturers Association

and the

University of California Sea Grant College
Marine Advisory Program (Cooperative Extension)



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CONTENTS

FOREWORD

During October 22-24, 1979, the University of California Sea Grant College Marine Advisory Program (Cooperative Extension) in cooperation with the National Marine Manufacturers Association co-sponsored the Second National Boating Facilities Conference. The focus of the conference was on facilities--the financing, designing, permitting, and operations and management of recreational boating developments. The conference was designed to be of assistance to a diverse national recreational boating audience.

The past few years have seen increased participation in recreational boating. Coupled with this increased activity is a growing shortage of boating facilities. The purpose of this conference was to provide a forum to examine the existing situation and offer some solutions. The papers presented concerned themselves with recent experiences, current problems, and future directions that the industry might pursue to remain a viable business.

The papers presented were organized into a series of six technical sessions. These sessions included, the Energy Outlook, Financing Marina Development, Design Considerations and Techniques, Permitting and Policy, and Boating Inventories and Waterfront Programs. In addition to the formal presentations, a field trip with on-site inspections of various San Francisco Bay Area marinas was conducted. At selected stops, questions about marina facilities construction, operation and management were discussed.

The papers in this proceedings should serve as a benchmark against which future trends in the recreational boating industry can be assessed. Consequently, this proceedings should be of value to planners, consultants, developers, operators, and other professionals with an interest in recreational boating facilities development.

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WELCOME ADDRESS

MAYNARD W. CUMMINGS
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I am privileged to be selected to say welcome to all of you here to attend the Second National Boating Facilities Conference. There are many here whom I would like to call by name but I am not going to; we are very pleased to see each one of you here.

I am going to mention only Mr. Bill Satow of the California State Department of Boating and Waterways and Mr. Ron Stone of the National Marine Manufacturers Association, co-sponsors of the Conference with the California Sea Grant College Marine Advisory Program.

Representing our organization and doing the programming and planning for the Conference were two University of California Marine Advisors, Andy Manus, the Marine Advisor for San Francisco and San Mateo Counties and Barbara Katz, who is the Area Marine Advisor for Orange and Los Angeles Counties where, as you know, there also is a modest amount of boating facilities and marine industry! Because of a conflicting commitment in a fisheries research project, Barbara is not here. I extend her regrets; her best wishes for your Conference are expressed in the work she did with Andy in its planning. He and Ron Stone will, I know, do everything possible to assist with any special requests you may have.

I am going to take advantage of this opportunity to say a few things about Sea Grant and especially its Advisory Services program, what they are and are not. Sea Grant is not the equivalent of the National Science Foundation (NFS) or National Institute of Health (NIH), not just a source of research funding. Research is Sea Grant's largest component but, like the Land Grant College Act after which Sea Grant was modeled, education and advisory efforts also are mandatory in the Sea Grant College Act. The intent of Congress in establishing Sea Grant a little over 10 years ago was to create an educational program regarding marine and coastal resources, emphasizing action in education which would transmit research results and other resource information to resource users in timely fashion. This is the mission of the Marine Advisory Program. About 20% of the California Sea Grant College budget goes to our Advisory Services which has a statewide network in the coastal counties of academic professionals whose job is extending information to many kinds of identified audiences.

There is a Sea Grant program in all the coastal and Great Lakes states and in most the working emphasis is with and for commercial fisheries. This is an important audience segment of the California Sea Grant Advisory Program, too, but by no means the only one. Major efforts also go to providing information in public marine science education, marine transportation, port management, aquaculture, coastal resources planning, sport fishing and other activities in marine and coastal recreation.

That last category includes this Conference which is our first program effort including the kind of audience you represent. Workshops and conferences such as this are some of the media used in Sea Grant advisory services educational programs. Along with many individual contacts, the advisory staff also prepares special publications such as the samples shown on the table and display board at the back of the room. There are many special publications in marine science, seafood technology, fisheries and California coastal zone regulation in addition to those on display. If you'd like a complete list of available publications just leave your name with Andy and he will see that you receive any you select.

From our organizational standpoint, I think it is appropriate that it can be held here at the Berkeley Marina since Berkeley is the administrative location for the University of California's 9 campuses. Sea Grant programs are conducted from 7 of these and also include program responsibility for Sea Grant work done at Stanford, Cal Tech, and a half dozen or so state universities and colleges.

I repeat that we are pleased to have this opportunity and I'm sure the co-sponsor representatives here will be glad to assist in every way to make your Conference visit enjoyable as well as informative.

WHO IS THE AVERAGE BOATER?

JEFF NAPIER
National Marine Manufacturers Association
Chicago, Illinois

It is my pleasure to try to set the stage and define in fairly specific terms what the average boatman's facilities needs are in the coming years. To do that we have first to find what the average boatman is in terms of the type of boat he has, where he uses it and where he would prefer to use it. We will also consider other related factors.

A quick way to get a handle on the average boatman is simply to look at the composition of the recreational boating fleet as indicated by industry sales statistics. Industry sales statistics suggest that there are approximately 11,270,000 recreational boats in existence on all waters in the United States. Of these, 6.6 million are outboard boats; 1.14 million are inboard boats including auxiliary powered sail boats and Coast Guard documented yachts; 880,000 are sail boats without inboard power; 2.65 million are rowboats, canoes, dinghies, prams and other miscellaneous craft, many of which are used with outboard motors and counted in the outboard boat statistic above. These boats use approximately 4.15 million boat trailers.

While most states register all motorboats, other types of craft are not necessarily registered. Accordingly, about 8 million out of the 11 million boats in use are registered and the rest - typically small unpowered rowboats and canoes - are not. We estimate that there are approximately 4,700 marinas and boat yards in the United States and about 1,300 yacht clubs with mooring facilities.

Last year boatmen spent almost 7 billion dollars on all types of boating equipment and services according to industry estimates. Professional people own boats in about the same proportion their numbers bear to the employed population in the United States (15-1/2%). Business managers and proprietors own more boats (15-1/2%) than their percentage of the population (10-1/2%). Clerical, sales and similar workers own boats in about the same proportion as their percentage of the population (24%). Skilled workers own boats at a significantly greater percentage (22%) than their part of the employed population (13%). Factory, service, farm and semi-skilled workers own boats to a lesser degree than their percentage of the employed population.

The majority of the recreational boats are trailerable outboards although, of course, this statement may not hold true for specific locations such as a coastal town or whitewater river area. Boat owners are, in the vast majority, very middle class in occupation and incomes; their boats typically cost anywhere from a few hundred to a few thousand dollars.

Most outboard boats are under 17 feet in length whereas most sterndrive and inboard boats are over 17 feet in length according to industry statistics. The distribution of various boat types tends to vary. California alone has 12% of the total inboard boat population in the U.S. with around 130 thousand such boats (including sterndrives). Florida is a distant second with 7% (about 80 thousand) inboards. Obviously such disproportionate predominance of certain boat types in an area affects the facilities needs and we will study this factor further in the program.

The marine industry, of course, is quite interested in determining the attitudes of its customers and potential customers regarding the attractiveness of boating. A very recent study just published by the industry contains some interesting data relevant to access to boating waters. First of all, I should note that the study involved interviews with both boat owners and non-boat owners in a national cross section representing the distribution of boat ownership. A summary of the pertinent study findings follows.

Under a major series of questions on the reasons for no longer owning a boat, former boat owners indicated that boat storage problems were No. 4 and lack of facilities were No. 6 - in rank out of about 30 reasons. Other interesting findings included the fact that most people feel their area is a good boating area but that docks are hard to find and one of the biggest problems with boat ownership is storing it during the off-season.

A series of statements were made in the survey with which the respondents were asked to agree and disagree. Among those with the highest level of agreement - by both boat owners and non-owners - were that boating is a relaxing, healthful non-competitive activity which anyone can enjoy and that a person can do many different things with a boat such as fishing, water-skiing, cruising, etc. Clearly boating and the need for facilities will grow in the future.

I mentioned that facilities problems were listed among the top problems associated with boating both by present boat owners and non-boat owners. Other reasons which I didn't mention - but which partially include facilities problems are the expense and difficulty or inconvenience of boating.

To summarize this part of the discussion, boating is very much a middle class American activity and many more would participate in it and those already participating would enjoy it more if there were more and better facilities for access to boating water. Clearly, that's what the 56 million Americans who went boating last year want based upon all objective studies as well as subjective opinions one can collect anywhere in the country.

Is fuel availability and price affecting boating? The answer is that availability, of course, affects boating. Wherever there is a shortage everyone cuts back on boating along with driving and other activities that use fuel. By cutting back we don't mean that people go boating less often so much as they simply go boating closer to home - if they can - saving gasoline both on the road and on the water.

And this brings up yet another facet of the facilities needs: facilities are needed where the people are - which is to say, in metropolitan areas. Interestingly, the vast majority of our nation's people do live in metropolitan areas and over 70% of the top 100 cities in our country are located on navigable waterways for the simple reason that our country was discovered and settled by water; waterways were the only highways back then.

Increasingly the focus for boating facilities development is on urban areas where many benefits - besides boating - can be reaped from an investment in boating facilities. For example, many urban waterfronts are deteriorated. An attractive recreational development such as a boat harbor not only provides a desirable asset to the limits of its own boundary but greatly attracts private redevelopment funds and reverses the decline of an area. This has been proven many times by specific projects throughout the country. Such developments with the recreational facility as the initiator, of course, create jobs and redevelop the municipal tax base as well. That's a lot of bang for the buck, if invested in a boating facility. Heritage Conservation and Recreation Service and the Office of Coastal Zone Management are publishing a handbook on urban waterfront revitalization, not incidentally, in recognition of this urban facilities need.

I'd like to spend the balance of my time talking about another specific item boatmen want in terms of boating facilities - merely the opportunity to pay their own way or, as the case may be, have those taxes which they already pay specific to their boating activity used for the benefit of boating. In the area of development of boating facilities with the funds of boatmen, there is a major piece of legislation pending in Congress known as HR 4310 - called the Biaggi bill (after its sponsor Congressman Mario Biaggi of New York City) which deserves the support of all of us.

The bill basically provides that 2/3 of federal marine fuel taxes, amounting to $20 million each year, will be made available to the states for recreational boating facilities development under a 50/50 matching grant basis. The other 1/3, about $10 million a year, is to be made available to the states on a similar 50/50 matching grant basis for boating safety services including enforcement, search and rescue, and boating safety educational programs. Under the bill, the new Recreational Boating Safety and Facilities Improvement Fund is administered by the U.S. Coast Guard.

The formula for allocations among the states for boating facilities development provides that 1/3 of the fund will automatically be distributed to all eligible states on an equal basis; 1/3 of the fund distributed according to each states share of registered vessels, and 1/3 according to how much each state is expending on boating facilities development. The object is to bring about an equitable allocation of funds between large and small states while at the same time providing an incentive to states to develop new recreational boating facilities and to earmark state marine fuel taxes for that purpose. The bill provides for coordination of boating facilities programs under the Boating Fund with those of the Department of Interior under the Land and Water Conservation Fund and with Coastal Zone Management Planning.

The bill is being vigorously supported by boatmen and the boating industry. It has been favorably recommended by the House Merchant Marine and Fisheries Committee and is now pending for the House Ways and Means Committee. It is hoped that the full House will pass the bill this year with Senate consideration next year. The legislation is fiscally conservative since it does not involve any new taxes but merely a reallocation of existing marine fuel tax revenues to give the boating taxpayer the opportunity to pay his own way. Support for HR 4310 is growing rapidly with many Governors as well as Senators and Congressmen on the record in favor. State boating law administrators and other recreational officials support it. It is certainly in the interest of attendees at this conference to support the legislation. It is this type of funding legislation that will make the concepts and plans we discuss here a reality throughout the country.

One more thing boatmen need in terms of facilities is simply better and more comprehensive listings of where facilities are located. This would help spread the load and provide more enjoyment and more places to go boating. I hope that these remarks have helped answer the question: Who is the average boater?

RECREATIONAL BOATING AND THE NATIONAL FUEL ISSUE

PATRICK DOYLE
Manager
Environmental Communications
Outboard Marine Corporation
Milwaukee, Wisconsin

FUEL AVAILABILITY FOR POWERBOATERS

At the outset, I wish to stress that the boating industry--throughout the 1979 boating season--has proceeded with the optimistic philosophy that if the boaters of the nation were careful in watching their fuel usage by boating in a fuel-conservative manner, there would be ample fuel available for normal recreational boating activities during this coming season. We have told our boating public, and it has been proven to be true, that we were confident that our federal energy regulators would allow that boaters from coast to coast would have fuel to use, and they will have it in the same equitable proportions as all other fuel users. We have seen, during this boating season, that over 90% of the U.S. has had an ample supply of gasoline for most of the summer months. We advised boaters that there would be periodic spot shortages of fuel in certain parts of the U.S., but that these spot shortages would be relatively short-lived, and this has been true also. Early in the boating season we saw interruptions in fuel supply distribution in California, and later in the Summer we saw temporary fuel shortages in some of the New England States, in New Jersey, in New York, in Washington, D.C., in Louisiana, and in parts of Texas. However, in each of these cases these temporary disruptions in gasoline supplies were rectified, and when gas lines dissipated, normal boating activities were quickly resumed.

The boating market, our manufacturing companies, and boating users have all labored at times under the Federal government's cumbersome handling of our national energy issue. As you well know, the President, his advisors, and our Federal Energy Office, and their energy plan proposals, have all sadly floundered. But, in spite of the cumbersome handling of our Federal Energy Plan in Washington, it remains true that boaters have been able to secure fuel in most of the U.S., and that our supply of gasoline at marinas from coast to coast has been good to excellent throughout the current boating season. We have seen the Congress reject proposals for weekend gas station closings (thank God!), and we have seen our legislators in Washington also reject several plans for gasoline rationing (again, thank God!). About the only remaining portion of legislation which the President is still pushing in his Energy Conservation Contingency Plan is the current "Standby Rationing Plan," which is undergoing a host of amending by Congress. Should this standby rationing program be accepted, we, in the boating industry, are confident that we will be treated in a fair and equitable manner, as Congress has promised in this standby program. It should be pointed out that any standby gas rationing plan adopted by Congress can only be put into effect if there is a 20% shortfall in oil imports into the United States. This would create a national emergency, and only then if the President and both Houses of Congress agree that a national energy emergency exists, would a standby rationing plan be adopted. Under this state of emergency situation, if one would ever be declared, boating would participate in a rationing plan along with the various segments of the very patriotic public sector. It is highly unlikely that our country will ever see a 20% reduction in OPEC oil imports, but if this catastrophe occurs, boating would be pleased to do its fair share in complying with a standby rationing plan.

As it stands now, it appears that the Federal government is placing the fuel conservation burden on each state government. Each governor will be free to draft his own individual plan to allocate state gasoline supplies in a fair and equitable manner to all fuel users within their particular state boarders. Boating will not be discriminated against, and we are optimistic that it will be "boating as usual" on the state waters throughout the nation.

--Concerning spot shortages of fuel, we, in the boating industry, have been in close contact with our associates in the oil industry, and they have told us that from time to time, because of refinery capacity problems of unleaded fuels, there might be shortages of the unleaded variety...but that leaded fuel, the type used in our marine engine products, will be far more abundant than unleaded gas throughout the boating season. This situation, also, has proven to be true during the current boating season.

--President Carter's recent energy decision to deregulate fuel prices and open up additional areas for more oil exploration bodes well for boating. It should provide additional incentives to our oil-producing companies to increase many facets of domestic oil production and, in turn, should help to provide additional future supplies of gasoline for all users--including boaters.

--Although gas prices have been considerably higher than normal, boating groups that we have queried from coast to coast report that they are continuing to pursue their normal boating activities.

We in the boating business and other marketers of recreation products occupy a unique position in the current energy issue. And this position, I believe, will give us significant "defenses-in-depth" concerning the use of energy. Recreation in the U.S. is an enormous contributor to our gross national product, and--more importantly--a fundamental part of our way of life. Various governmental officials, tourism directors, and boating industry leaders have stated quite bluntly that--"No crisis of any

type will stop the American public from pursuing its leisure activities." We are encouraging the boating public to continue to boat, but we are asking them to do it in a more fuel-conservative manner by throttling back one-quarter. This throttling back saves between 20 and 48% of fuel used, depending upon boat and motor combinations.

ESSENTIALITY OF RECREATION IN MODERN MAN'S LIFE STYLE

With over 74% of our populace living on only 1-1/2% of our land, we have become an urban-oriented society. And with the pressures of daily life growing at unprecedented levels, one of the prime necessities facing this nation is how to make it possible for our urban dwellers to periodically get away from these metropolitan pressures to enjoy their leisure time pursuits. Recreation, in today's society, has become a most essential activity of man. Following are various facts which support the need for recreation/leisure as a necessity to man's physical and mental well-being -- today more than ever in our history.

-- Sociologists and psychologists have long supported man's demand for recreation. One sociologist said, "Leisure and labor are the two sides of man's shield. Both protect him; labor enables him to live, and leisure makes the good life possible."

-- During the Arab Oil Embargo of 1974, Senator Gaylor Nelson (Wisconsin) issued a statement to the Department of Energy on the essentiality of recreation and boating. He said, "Outdoor recreation is an indispensable part of American life, contributing to the physical and mental health of our public. Boating and fishing and similar activities are virtually the only source of recreation for millions of Americans of modest means who cannot afford to jet off to Europe or the Caribbean for their vacations." In short, Nelson stated, "Recreation in the U.S. is not a non-essential activity."

-- Even Aristotle addressed this issue. In his treatise "POLITICA," he said, "We labor to have leisure!"

-- Margaret Mead wrote extensively on the relationship between labor and recreation for man. In her work, "The Model Week," she said, "Recreation is something done to get you safely back to work again in a refreshed state of mind."

-- Dr. Jay Nash, in discussing the problems which accompany our industrialized and urbanized world, stated: "Mental and physical fatigue in our work force cause society to become sluggish and unproductive." He concluded that the immediate antidote for these work-related fatigues is recreation. "If man can let down, engage himself in some type of outside activity, and periodically can lose himself in this activity, he will be restored shortly to normality and productivity."

-- One sociologist stated simply, "Recreation yields a positive feeling, the sensation known as fun. In recreational pursuits, man can become, for at least the duration of these leisure activities, the master of his own life."

-- Dr. Alexander Reid Martin, former chairman of the Leisure Activity Committee, American Psychiatric Association, concluded a recent report stating: "Perhaps man gives himself more free time and recreation at this period of his history because he demands it to meet the challenge of his rapidly expanding inner and outer world."

Based on the above reasons for man's need for recreation, we, in the boating and recreational industry, believe it is imperative that our governmental officials continue to work and promote programs designed to enable man (and our predominantly urban society) to pursue and experience the joys and refreshment of recreating in outdoor leisure activities in an environment removed from the complexities of our metropolitan communities. We applaud government and its various agencies, concerned with recreation, for the attention it has given to the continuing development of our outdoor recreational facilities. We appeal here for a continuation of these recreational programs for the overall well-being of our citizens.

ECONOMIC IMPACTS OF BOATING

Permit me here to quickly enlarge on what impact leisure spending has on our overall economy. This market...which includes recreational products, equipment, activities, vacation spending, recreational trips, second homes, and the like...contributed more than $200 billion to our nation's economy last year. The increase in leisure for each of us has grown to the point that:

-- Leisure spending now exceeds our national defense expenditures.
-- It is more than the total outlay for all new home construction annually in this country.
-- It surpasses the total of our nation's entire corporate profits, and exceeded the overall value of the U.S.'s total exports.
-- One out of every 20 persons in the U.S. is employed in the leisure/recreation/tourism industries.
-- A Department of Interior survey reveals that 75% of the U.S. population, from age nine upward, is involved consistently in some form of outdoor recreation.
-- And, with shorter work weeks entering the scene, economists are predicting that the total annual dollar volume for leisure time expenditures will more than double in the next 10 years.

Now, let's look specifically at the marine industry contribution. A very quick review of the national economic impact of the marine industry reveals the following: The recreational boating business is made up of 19,000 firms directly engaged in producing and selling marine products. It provides jobs for 1/2 million employees. Retail sales for our industry exceed $6-1/2 billion annually.

Other facts showing our economic vitality include: annual payroll of $3 billion, a retail dealership of 16,500 firms, and over 2,500 marine product manufacturers. Engine-powered recreational boats in this country represent assets worth $36 billion, and in 1978 there were over 11 million recreational boats registered from coast to coast. And, of major significance, more than 56 million Americans go boating at one time or another each year. These millions, however, use less than 1/2 of 1% of the nation's total fuel consumption, the equivalent of one-half tank of gasoline for every auto in the country each year. The economic consequences of curtailing fuel for boating far outweigh any conservation savings achieved by any restrictions placed on powerboating.

-- Using Wisconsin as an example of the economic impact of boating at the state level, the following facts are most impressive: The state's 1,530 marine product dealers account for more than $200 million in new marine product retail sales. Wisconsin boaters spend an additional $200 million each year for used boats, motors, servicing, docking fees, storage, repairs, fuel, and boating club memberships. The state's 1,400,000 fishing licenses (a large percentage of these fishermen use boats) contribute $6-1/2 million to state funds. In addition, powerboaters in Wisconsin contribute nearly $3 million in fuel taxes. There are more economic contributions to the state by boaters (including ancillary monies spent at motels, restaurants, grocery stores, bait and tackle shops), but we mention the above as a case in point for boating's economic impacts at the state and local level.

MINIMAL FUEL USAGE BY NATION'S POWERBOATERS

As an example of the fact that boating is not a fuel-intensive activity, it is interesting to state that autos operated in California, just during the month of July, consume more gas than does the entire powerboat industry in a boating season.

Last spring, during the Iran political turmoil and oil supply interruption, we in the marine engine industry issued the following statements to our sales force, dealer organizations, and customers to allay fears about the energy situation:

-- During any oil import slowdown because of Middle East political inconsistencies, boating industry sources and U.S. oil industry leaders believe that there could be temporary and minor disruptions in various parts of our nation in the gasoline distribution system. This may pose inconveniences at times if these temporary gasoline interruptions occur, but we feel confident that these problems will be less troublesome than they were in 1974.

-- Our boating industry Energy and Government Relations Committees, trade association staff, and Outboard Marine Corporation personnel will closely monitor forthcoming proposed Federal Energy Administration regulations to make certain that our industry will continue to receive equitable treatment, and not be discriminated against in our energy usage.

-- A great many of the nation's motorboats are used for sportfishing, an activity which consumes very little fuel.

-- The nation's 9 million boat owners, with $36 billion invested in their equipment, are not requesting special consideration. They only ask fair and equitable treatment and will be willing to make their fair share of necessary sacrifices in a fuel shortage. A major premise in the boating market -- is that the nation's boaters are enthusiasts for the pleasures derived from their favorite leisure pastime, and will not stop boating, even if present-day economic and inflationary forces cause slightly higher fuel prices.

-- Compared to other recreational activities, boating is a relatively small consumer of fuel. Research reveals that persons driving to professional and collegiate sports events, for example, use far more gas per year than that used in powerboating.

-- A survey of powerboat usage, conducted among a cross section of boat and engine sizes in a variety of waters in different parts of the nation, documented that boaters operate in a fuel-efficient manner. The survey indicated that boaters spend 30% of their operating time at idle. They operated 60% of the time at fuel-efficient cruise ranges; only 10% of the boating time was spent in the high throttle ranges, with less than 2% of their time being at wide-open throttle operation.

-- A recently completed statewide survey of boaters in Wisconsin, the fifth largest boating state in the nation, has revealed that the average boater in Wisconsin consumed only 60 gallons of gasoline per boating season. This survey -- conducted by the state's Department of Natural Resources among a broad cross section of boats of various sizes -- is the most supportive documentation yet of the boating industry's contention that we use less than 1/2 of 1% of all fuel consumed by the nation's engine-powered products.

THE TRUE AMERICAN POWERBOATER: "EXPLODING THE MYTH THAT BOATING IS A 'RICH MAN'S' SPORT"

Another issue which requires comment is the demographic "make-up" of the recreational boating market. An erroneous assumption exists in the minds of many that boating is a "rich man's sport." In metropolitan areas, and in communities bordering our ocean shores, and Great Lakes, the typical citizen has driven past marinas and yacht clubs where larger boats and yachts are moored. Viewing these larger craft, it is easy to surmise that everyone who boats has a large yacht, and is therefore a wealthy, affluent member of society. Nothing could be further from the truth.

In reality, surveys over the years conducted by the U.S. Coast Guard in its report on recreational boating in the continental U.S. entitled, "The Nationwide Boating Survey," coupled with market research facts from the National Boating Trade Association, presents the following picture of the typical U.S. boater:

-- U.S. boaters are not predominantly users of large yachts. Industry statistics reveal that the average powerboat is a small 14 to 16 foot boat powered by an outboard motor of 50 h.p. or less, with a trailer to match.

-- The average price for the typical "powerboat package" is approximately $2,500.

-- The typical powerboat is used mostly to go fishing (46.5%).

-- Powerboaters are not wealthy, they are mostly "middle Americans." The National Boating Survey conducted every three years by the U.S. Coast Guard, as well as industry marketing research facts, portray the following picture of the typical American boater:

  * He is 34 years old, a family man with three children.
  * Eighty-seven percent of boating households earn less than $15,000 annually. Only two percent earn more than $25,000 annually.
  * Fifty-eight percent of all powerboaters use engines less than 50 h.p. in size.

-- These facts indicate clearly that the American powerboater is not an overly affluent member of society. He is, in fact, a blue collar worker in the "middle income" bracket, who uses a small outboard-powered boat. It is this segment of society that bears the heaviest burdens of taxation, inflation, economic uncertainty, unemployment, and the other factors that hit hard in times of traumatic national crises.

MARINE ENGINE MANUFACTURERS COMMITTED TO PRODUCING FUEL-EFFICIENT PRODUCTS AND TO PROMOTING FUEL CONSERVATION

Since the oil embargo days of 1973-74, the boating industry has worked to both educate our engine users and communicate with federal government officials about how our industry can successfully conserve fuel and still continue to enjoy boating as a favorite form of recreation. Some of the details of our information program have been:

-- Educating marine engine users how to keep their engines in top operating condition for maximum efficiency, and advising them to throttle back 25%. This 25% reduction in throttle setting will save between 30 and 50% on fuel consumption, depending on boat size and engine combination.

-- We have advised energy officials that modern outboard technology has improved engine efficiency over the years. Our new 55 h.p. outboards, for instance, use 1/3 less fuel at open throttle than the comparable 50 h.p. of 20 years ago, and far less at reduced throttle.

-- We have pointed out that since 74% of us live in major metropolitan areas, that nearly all of three key population centers are either located on, or are very accessible to, large bodies of water. This, of course, means that unlike many other leisure activities, boating can be carried on without the need for extensive travel. Our users can be encouraged to enjoy their boating while staying close to home, conserving fuel.

-- We are asking the government to aid the boating industry to increase launching and mooring facilities near these urban population centers, and improve access to our shores for more and better boating accommodations.

-- We will also encourage the development of better fish stocking programs near these urban areas. We all have watched with extreme pleasure the boom that has taken place on the Great Lakes with the introduction of salmon, trout, and other game fish. This great fishing activity has resulted in thousands of boaters in Chicago, Milwaukee, Detroit, and other cities to use their boats at home to enjoy this fishing bonanza, rather than trail them to distant, inland lakes. Additional government sponsored fish stocking programs could add to this excellent fuel conservation development.

-- We have told regulatory people that boating, by its very nature, is not a fuel-intensive activity. Boating is a multiple passenger experience. Seldom do we see one person in a boat; it is usually done in the company of others, so the fuel used to propel the boat is shared by others. A recent Department of Transportation energy research project reported that "The average model efficiency in the powerboat market is estimated at 22 passenger miles per gallon, representing a mean of 3.6 passengers per boat." And, also, these same users are not consuming fuel in some other engine-powered activity while boating. This placed powerboating high on the fuel-efficient activity list.

These are some of the points we have been promoting to show how the boating public will be asked to contribute significant savings in fuel consumption. These programs will result in a significant fuel saving in the recreational boating area. We are confident that it will be "boating as usual" in a very healthy and prosperous marketplace for our industry this year, and on into the future. A little "belt tightening" by our normally conservation-minded boaters will be good for all of us...and will in no way curtail our boating pleasures.

Since energy is such an important facet of the powerboat market, we have ample incentives to increase the efficiency of our marine engines. We really don't need any additional prodding from governmental agencies to make these efforts. Good business sense prompts us to be energy efficient; our users are demanding it, and the sting of government regulations in this area is truly unnecessary.

The marine engine industry has a long-term commitment to achieving greater efficiency for its engines. Our engine manufacturers have expended considerable sums of money during the past 15 years to achieve improvements in energy efficiency. Power plants designed and adapted for marine use have achieved a high degree of sophistication. Improvements have resulted from many individual contributions rather than any single innovation.

The following are some of the developments which have contributed to the efficient modern outboard engine:

-- Tuned exhaust system and loop scavenging through hub exhaust.
-- Higher engine compression and better intake and exhaust porting.
-- Pressure-backed piston rings for reduced friction.
-- Antifriction bearings and reduced fuel/oil ratio.
-- Improved induction system and elimination of crankcase drains.
-- More precise carburetor calibration.
-- Improved combustion chamber design.
-- Capacitor discharge ignition with tailored spark and throttle advance (less misfires).
-- Thermostatically controlled cooling systems.
-- Hydrodynamically designed lower units and propellers.

FUEL CONSERVATION TIPS FOR POWERBOATERS

These technically improved marine power plants, coupled with the following tips which boaters can apply to their operating procedures, combine to provide fuel-efficient operation:

-- Properly tuned engine--this would provide fuel and ignition systems in "like new" factory supplied condition.
-- Be sure your rig is set up at maximum efficiency--a difference between a properly rigged unit and one not rigged properly can be as much as 5 mph. Translated into fuel efficiency, it could mean the same performance on 10-20% less fuel.
-- Check motor height--the lower the motor, the greater the drag, and the more fuel used. Get motor up out of the water as far as possible, just short of the point where the propeller breaks out of the water and ventilates on sharp turns.
-- Check motor trim. Ride a clean plane, eliminate plowing or squatting. Proper trimming reduces the amount of hull contact with the water surface, keeping power-wasting friction to a minimum.
-- Check propeller. (1) At wide open throttle, if engine isn't running in its recommended operating range, it's not properly propellered, and (2) bent, nicked, or damaged propellers will detract from efficient fuel operation.
-- Check boat bottom. If you store a boat dry, on a lift or a trailer, check to see that the bottom is properly supported to eliminate developing a "hook" which reduces planing efficiency. Keep boat hull clean from road tar and film, and keep clean to prevent build-up of marine growth which can cut speed and increase drag up to 40%.
-- Throttle back. The last 20% of throttle can cost you 30-40% in fuel. Operate at lowest speed at which you can maintain an absolutely clean planing attitude. Greatest fuel conservation is a throttle setting of about 2/3 to 3/4 of recommended full throttle operating speed.

Booklets containing these and other fuel-saving techniques to provide continued boating pleasures at the most fuel-efficient ranges are being distributed to boaters by our company's Evinrude, Johnson, and OMC Stern Drive marketing groups, and others throughout the boating industry.

BOATING URGES GOVERNMENT TO "TAKE WRAPS OFF" TECHNICAL COMMUNITY IN QUEST FOR ENERGY SELF-SUFFICIENCY

Concerning our national energy policy, we should be most unhappy with the present administration which has never been able to see that there are other answers to our energy problems than conservation and politically expedient and exotic energy sources such as solar power. At Outboard Marine, and throughout the boating industry, we applaud the recent decision to decontrol the oil industry...and we believe that there is really only one viable solution to our national energy shortfall...and that is for our government to "take the wraps off" our technical community in terms of excessive regulations, and assist in helping this country to become more self-sufficient in its energy program. Let's provide incentives, and remove restrictions on industry now impeding development of new oil technology and domestic oil recovery. We certainly have the technology and, according to oil industry experts, we have ample undeveloped resources available domestically to do the job.

THE OUTLOOK FOR BOATING UNDER PRESENT ENERGY CIRCUMSTANCES

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The actions of foreign oil producers, that is members of the Organization of Petroleum Exporting Countries, and responses by the U.S. Government to those actions pose a threat to recreation activities more immediate and severe than that to the U.S. economy overall. Boating enthusiasts and those whose business it is to serve boaters, therefore, must take steps to protect their interests. As a matter of self-preservation, boaters must consider a more active and direct role to promote fuel conservation and to call upon the U.S. Government to adopt a more progressive, supply-oriented energy policy than that which now prevails.

CURRENT ENERGY PICTURE/OUTLOOK

Despite continuing threats of petroleum supply disruptions and price increases, the U.S. is now more reliant on petroleum to supply energy than at the time of the Embargo in 1973. The proportionate use of coal and nuclear energy have declined while oil and natural gas have taken up a slightly higher proportion of energy supply since 1973. Perhaps, worse yet, we rely more upon oil supplied by the Organization of Arab Oil Exporting Countries (OAPEC) -- the 7-nation group which imposed the Embargo -- than we did in 1973.

A consensus forecast among energy analysts suggests that the present mix of energy sources is not likely to change significantly in the next 10 to 15 years -- nor is our dependence upon imported oil expected to decrease, over that time frame. Now, roughly 25% of U.S. energy supply is imported, most of it as crude oil. The generally accepted range of energy forecasts for the end of the '80s suggests that dependence upon energy imports is likely to increase by 1990 in order to maintain an acceptable rate of growth in our economy.

Alternatives for oil and natural gas -- sometimes called synthetic fuels -- which include liquefaction and gasification of coal may be promising for the long run. In the near term, certainly during the '80s, and perhaps well into the following decade, we must make the most of our domestic oil resources -- supplemented by imports -- together with natural gas, coal and atomic energy.

Continued U.S. access to foreign oil is not limited by physical constraints of resources. Proved free world reserves, in physical terms, are adequate to satisfy free world needs at present levels for at least thirty years, and likely far beyond -- the key issue is access to foreign crude supply under diplomatic and trade terms which are mutually acceptable to the U.S. and principal oil exporting countries.

U.S. ENERGY POLICY

During two previous oil supply disruptions -- the 1973 "Embargo" and the 1978-79 "Iranian Crisis" -- the U.S. Government called for the weekend closing of service stations, among other actions, in order to constrain gasoline demand. The impact of closed stations on weekends tends to be devastating to the recreation and entertainment industries.

The problems arising from generally tight oil supplies have been exacerbated on occasion by the Department of Energy (DOE) price and allocation regulations. For example, early in 1979 serious regional shortages of gasoline were experienced beginning on the West Coast, and eventually spreading eastward. The DOE allocation rules, in force at the time of the Iranian oil cut-off in 1978-79, were based on 1973 demographic circumstances. With a major shift of population to the "Sun belt" States in the intervening 5-year period and with allocation rules slow to respond, it was no mystery early in 1979 when long lines appeared at service stations in California. Instead of working to smooth the flow of limited gasoline supplies, the allocation rules tend to worsen the effects of maldistribution.

NEW PETROLEUM PRODUCTION AND REFINING POLICY

At this time it is important that the U.S. Government consider the necessary steps to encourage exploration and production of domestic crude oil and to maximize refinery production of fuels for transportation. Concurrently, government policy should encourage displacing petroleum by coal as boiler fuel. Such policy actions have the potential to effect significant improvements in the supply of transportation fuel. To date most governmental actions have not encouraged appropriate actions by industry and consumers.

It is especially important to note the extent to which the U.S. refinery industry has been affected adversely by regulation. In the period 1972 through 1978, the yield of gasoline as a fraction of crude runs in U.S. refineries declined significantly. A progressive refinery policy which would encourage U.S. refiners to invest in additional gasoline manufacturing equipment would substantially increase

the volume of motor fuel from each barrel of oil. Appropriate investment across the domestic refining industry could add as much as 1 to 1.5 million barrels per day additional motor fuel production at the present levels of crude oil input. The constraints to such investment are principally a function of adverse regulation, therefore, the solution is to remove the restrictions thereby encouraging refiners to upgrade refinery yields, that is, to increase the amount of gasoline obtained from each barrel of crude oil.

CONSERVATION

Obviously every effort must be made to conserve energy. The greatest potential to save fuel can be realized by producing more efficient automobiles. Unfortunately, to substantially modify the large U.S. stock of automobiles will require a time-frame of some 10 to 15 years. There is a need, therefore, to take actions which can produce more immediate results.

Household use of gasoline can be divided into three principal categories -- commuting to work, family business, and recreation. To manage conservation of motor fuel in the near term the greatest pay-off can be obtained by tackling the most organized part of travel, that is, commuting to work which accounts for roughly 40% of urban household gasoline consumption.

Aggressive promotion of ride-sharing has been demonstrated as an effective means of gasoline conservation -- car pools and van pools.

There is also considerable fuel saving potential in ride-sharing for family business, that is, the shopping trip, the trip to clubs, etc. Since these trips tend to be less organized than the work commute it is more difficult to accomplish significant levels of ride-sharing.

Recreation travel is, or course, the least organized part of household travel -- nevertheless, every effort should be made to conserve fuel in recreation use. But the point to be made is this: by making a maximum effort to conserve fuel in commuting and family business the fuel saved can be directed to weekend use in order to continue recreation activities. This strategy is more than just an alternative to closing stations on weekends in order to reduce consumption of gasoline -- it is a most effective step toward preserving recreation travel.

CONCLUSION

The gasoline supply situation for recreational boating need not be as bleak as present perceptions may suggest. Barring a major political confrontation between the major petroleum exporting countries and the consuming countries, an energy policy which includes a well-coordinated conservation effort coupled with the removal of the present constraints on the domestic oil industry can provide adequate fuel to supply a healthy recreation industry within a strong U.S. economy.

Recreation is a generally accepted social good. To promote its viability boating enthusiasts have little choice but to become actively involved in issues outside their customary fields of endeavor. Boaters can take two steps to assure the preservation of their sport. First, gasoline must be conserved -- boating enthusiasts have to take an active role to promote such programs as ride-sharing and public transit in their communities. Second, the supply of gasoline for recreation must be reasonably assured -- this means that those protecting the interests of boating must take the initiative to move legislators to promulgate progressive policies which will encourage the development of additional domestic petroleum production. In addition the gasoline processing capability in domestic refineries must be upgraded to provide the maximum yield of gasoline and other transportation fuel from each barrel of crude oil.

FINANCING MARINA DEVELOPMENT: AN OVERVIEW OF CALIFORNIA'S PUBLIC PROGRAM

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As the State's boating agency, the California Department of Boating and Waterways (Cal Boating) provides a variety of programs for the construction of boating facilities on lakes, rivers, bays, and coastal areas. These facilities provide public access to the State's waterways and are planned for a wide spectrum of boating activities, including fishing, sailing, cruising, ocean boating, and water skiing. Funds used for the development of boating facilities come primarily from the California boat fuel tax fund and various State recreation bond monies. Most of our development funds come from the taxes paid by boaters to propel their boats. This program is a unique one in that boaters pay into a special fund and the boaters are the recipients of the benefits generated by boating facility projects constructed with these funds.

In order to meet the increasing demand for trailerable and cartop boat facilities, the Department provides grants to cities, counties, and other governmental agencies for the development of boat launching ramps and ancillary facilities. The grants can be used to construct launch ramps, courtesy boarding floats, car/trailer parking areas, lighting, landscaping, restrooms, and utilities. Once a grant has been fully approved, a construction and operation agreement is executed by our Department and the local agency receiving the grant. The agreement specifies a number of conditions that must be met, including: (1) the Department must review the plans and specificiations of the proposed project; (2) the facility must be open to the public free of charge; and (3) the local agency must agree to operate and maintain the facility for a period of twenty years.

In addition to our grant program, Cal Boating plans and funds the development of boating facilities throughout the State Park System, on reservoirs of the State Water Project, and on other State-owned lands. These facilities include the development of "boat-in" day use and camping areas, docks, and boat launching facilities. Overall, in the past decade and a half, the Department has provided funding in the amount of $30,000,000 for 290 launching lanes, "boat-in" areas, and other boating improvements throughout the State.

In 1977, the Department was authorized by the Legislature to provide grants to governmental agencies for the installation of floating restrooms on bodies of water where conventional restrooms cannot meet the needs of boaters and where the presence of floating restrooms may lessen environmental degradation. To date, the Department has installed floating restrooms, also known as the "S.S. Relief," on eight lakes throughout the State and the program has been a demonstrable success. An illustrative example is at Folsom Lake, near Sacramento. During the summer at Folsom, the floating restrooms, which contain double-walled, 500 gallon sewage holding tanks, need to be emptied once every two weeks due to the heavy use they receive.

In addition to our programs for the construction of boat launching facilities and "boat-in" areas, the Department provides low-interest loans to cities, counties, and special districts for the construction and improvement of small craft harbors. Marina facilities funded by our Department can include the construction of breakwaters, harbor basins, berths, mooring buoys, restrooms, harbor masters' offices, erosion control, bank protection, environmental enhancement, landscaping, fuel docks, park benches, sewage pumpout stations, public shoreline walkways and utilities. Berthing facilities can be provided for recreational as well as commercial fishing vessels. Since 1958, Cal Boating has provided approximately $70,000,000 for the construction of marinas throughout the State, with a total capacity of 9,300 berths. On the average, the Department appropriates $8,250,000 each year for marina construction loans.

Environmental issues have played an important role with respect to the development of marinas in California. Substantial environmental mitigation and enhancement are involved with the construction of new marinas. The Benicia Marina, presently under construction in Solano County in northern California, included the creation of a 19-acre marsh area to enhance the surrounding ecological habitat.

An application from a local governmental agency for loan funds for the development or improvement of a small craft harbor must include a project feasibility report, an environmental impact report, and a resolution from the local governing body requesting the project. The financial feasibility of the project is of prime concern as it indicates the ability of the local government to repay the State loan on a timely basis. Typically, revenues generated within a designated project area, including berthing fees and restaurant, hotel, and other lease-concession rents, are used to repay the loan. Berthing fees alone are usually not substantial enough to make a project feasible, thus other concessions are needed for a fiscally secure development.

A general philosophy of the loan program is that we try not to compete directly with private marinas, but rather complement their activities. Several of our marina projects have been constructed with the assistance of private lease concessions. In such situations, concessionaires construct and operate the berthing facilities after we have funded the construction of the harbor basin and landslide facilities. However, even with the combination of public and private financing of marinas, the development of boating facilities has lagged far behind the demand. The need for additional facilities is evidenced by the long waiting lists for slips at marinas, supply and demand studies done throughout the State, and the dramatic rise in the number of registered boats during the last 18 years, from 225,000 in 1960 to 554,000 at the end of 1978. The demand for additional berths is estimated to be over 10,000 in southern California and approximately 5,000 in the San Francisco Bay Area. The need for additional marina facilities is well illustrated at the Long Beach Marina where the City of Long Beach maintains a list of over 3,000 boaters waiting for slips.

In order to ensure that the projects funded by Cal Boating conform to high construction standards and at the same time remain cost efficient, the Department has developed a set of standard drawings and specifications for the primary features of boat launching facilities and marinas. For example, we maintain current "state-of-the-art" drawings for boarding floats that adjust automatically to fluctuating water levels, concrete ramps with a special V-grooved finish for added traction, parking standards, and guidelines for the development of harbor basins and slip and pile construction.

During the last ten years, the development of public marinas has changed to reflect a greater concern for a number of important issues, including the dredging and filling of wetlands, the ecology of the native habitat at the marina site, public access to the shoreline, and visual and aesthetic appearances. Because of these concerns, mitigation measures and public amenities play a very important role in the marina development program. Park benches, shoreline walkways open to the public, restrooms, attractive landscaping, and the creation of marshes all contribute to more aesthetically pleasing and environmentally acceptable projects. For these reasons, the Department's marina development program in the past few years has, and in the foreseeable future will concentrate on: (1) expanding existing marinas for better utilization of the water area; and (2) improving old and dilapidated marinas to renew the attractiveness of our waterways and to generate greater public use of our water resources. Realistically, we do not anticipate the construction of any new harbors along the coast of California.

We believe we have established a successful boating facility development program in California that is relatively free of red tape and responsive to the needs of the boaters as well as environmental concerns. Barring any unforeseen obstacles, we hope to continue this tradition into the future.

THE ECONOMICS OF FINANCING MARINAS

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My topic, The Economics of Financing Marinas, is one that I am sure is of interest to all of you, particularly in these times of high interest rates, tight money, and increasing costs due to our excessive inflation. My presentation will deal with five basic areas of concern: 1) I will present comments on marinas in the Pacific Coast states of Washington, Oregon and California; 2) I will point out changing characteristics of marina development in the Pacific Coast states; 3) I will discuss basic economic considerations involved with the financing of marinas; 4) I will review the historic sources of funding the capital improvements involved with marinas and trends in that regard; and 5) I will present forecasts of changes that I foresee in the next 5 to 10 years for marina development in the Pacific Coast states.

MARINAS IN THE PACIFIC COAST STATES

Will Rogers said "Buy land, they're not making any more of it." I think today's facts of life merely fortify Mr. Rogers' philosophy, and this is particularly true with waterfront land. I would change his statement slightly, however, to say "Buy land, they're not making any more of it and what we have is becoming more difficult to develop, particularly for marinas and waterfront residential and commercial projects." With this in mind I think that I will start my discussion by a classical definition of a marina. A marina is a small craft harbor complex that includes most or all of the support and ancillary facilities needed or desired by boatmen, such as launching equipment, repair facilities, fueling, restrooms, marine hardware supply, and food services. The term, of course, is being broadened by our contemporary marina development patterns here on the West Coast. The term marina is normally used to describe harbors that are intended primarily for recreational craft.

As I mentioned before, the focus of my discussion will be on West Coast marinas in the states of Washington, Oregon and California, with particular emphasis on California. In our West Coast states, marinas vary in size and character. In California, for example, we have approximately 550,000 registered boats, the huge majority of which are recreational craft. In the latest inventory conducted by the California Department of Boating and Waterways (Cal Boating) it was determined that some 640 marinas existed in California. They had an average size of 128 berths. The total berths within the 640 marinas amounted to 82,300. For convenience in discussion I have broken the state down into four areas. The first area, and the area of heaviest boating demand in California, is the South Coast area which includes the four Southern California coastal counties of Ventura, Los Angeles, Orange and San Diego. In this area exist 44 percent of the total berths within marinas in the state, a total slip count of 36,300. The average size of marina in the South Coast area is 212. The largest marinas in the state of course exist in this area. Here in the San Francisco Bay Area, 20 percent of the total berths within marinas in the state exist, an amount of 16,300 slips. In our Delta area, the Sacramento-San Joaquin delta area just east of here, there is a total of 9,500 slips, 11 percent of the state's total, and the average marina size there is 90 slips per facility. In the remainder of the state there exist some 20,200 slips or 25 percent of the state's total. In this area the average marina size in terms of berths is 79. Obviously you can see that this area represents the North Coast, the many rivers, foothill lakes and high mountain lakes where many of the marina facilities are very small in nature and to some extent seasonal.

Now let's turn to the state of Washington. Washington has an estimate of 200,000 recreational boaters. This is an estimate made by the U.S. Coast Guard since the state does not have boat registrations similar to California or Oregon. A recent survey conducted by the Oceanographic Institute of Washington under a Washington Sea Grant Program inventoried marinas in the Puget Sound, the Strait of Juan de Fuca, the outer Pacific Coast, the fresh water lakes in the Seattle area, Lake Union and Lake Washington, and on the Columbia River Washington side from the mouth to generally the Portland area. This inventory indicated that the state had 240 marinas in this area with a total of 24,400 wet moorage slips. Up in the Northwest, the term "berth" is not used. Most of the time you talk about "moorage slips." Of this 24,400 wet moorage slips, over 30 percent exist in King County, the location of Seattle and the most populous county in the state. Seventeen percent of the moorages are in Pierce County where Tacoma is located and in Whatcom County, the county in which Bellingham is located, which adjoins the Canadian border and the Vancouver, B.C. area. In Washington the average marina size is 102 moorage slips. In the Central Puget Sound area and on Lakes Union and Washington 27 percent of the marinas in the state are located here and these marinas include 36 percent of the total moorages. The average moorage size in this area is 136 moorage slips, a good deal larger than the average statewide.

Now let's turn lastly to Oregon which has a registered boating population of about 125,000. Oregon marina development is primarily in the Portland area on the Columbia River, to some extent on the

Willamette River and on the Oregon coast. The state has far less marinas than either California or Washington. For example, the total moorages within the four-county Portland metropolitan area total only 5,400 moorage slips.

CHANGING CHARACTERISTICS OF MARINA DEVELOPMENT IN THE PACIFIC COAST STATES

A number of things relating to marina development are changing in the Pacific Coast states. These are generally summarized below.

1. Marinas are getting larger. Marina development does work on the theory of economies of scale. In addition, since marinas are becoming more difficult and costly to build, once they are built they have to be large and provide ample facilities to offset their higher cost. Examples of large marinas in California are at Marina del Rey with a total of 6,000 slips, Berkeley Marina, where we are now, is the largest marina in the San Francisco Bay Area with a slip count of slightly under 1,000, and on the Oakland waterfront, where you will probably tour in the next couple of days, there are 13 separate marinas with a total slip count of 2,300. In Oregon the newest and largest marina is now under construction. This is a 600-moorage slip facility being constructed by the Port of Newport in Lincoln County on the central Oregon coast. This project is referred to as the South Beach Marina. It is strictly a recreation marina. Another large project that was completed last year in the Portland area is the Hayden Island Sailboat Moorage, a 300-slip marina developed by private enterprise. In Washington State the largest marina is Shilshole Bay Marina, a 1,500-moorage slip facility on Puget Sound that was developed some 15 years ago by the Port of Seattle. In Everett, a town 30 miles north of downtown Seattle in Snohomish County, the existing 1,000 moorage slip marina is being doubled in size to where the new 2,000 slip marina will be the largest recreational harbor in the Pacific Northwest. Another recently completed new harbor exists in Whatcom County at Point Roberts. This project was developed by private enterprise and has 1,000 moorage slips.

2. Marinas are becoming more multiple-purpose projects. Marinas' land-side development is changing in character. We're seeing much more in the way of residential and commercial development, both marina oriented and non-marina-oriented occurring adjoining marinas. This is a pattern that was established with the construction of Marina del Rey and Redondo Beach King Harbor in Southern California. It's continuing, however, in Oregon with the construction of the South Beach Marina at Newport and the proposed South Downtown Marina in Portland on the Willamette River. In Washington this trend is occurring at the new Everett Marina and is proposed at the new marina that will soon be constructed in downtown Olympia, the East Bay Marina, which will have a major waterfront commercial center.

3. Marinas are moving downtown and are becoming attractive amenities for center city redevelopment programs. Those of you who have traveled to Florida and to many of our East Coast cities know that marinas have been and continue to be used as amenity projects to complement downtown redevelopment. This trend is also occurring on the West Coast. It is vigorous and healthy and I expect it to continue. Examples of such marina projects in California include marinas on the San Diego waterfront, Redondo Beach King Harbor, the San Francisco Pier 39 project, which you will see on your tour, and the marinas along the Oakland Embarcadero. In Southern California a major 1,700-slip downtown marina for the City of Long Beach is now in final design. This $26 million project was being turned down by the California Coastal Commission and the Local Coastal Program committee, when last year the citizens through referendum placed the issue on the ballot. It received a 60% favorable vote and was thereby revived from the grasp of the environmentalists. Examples of downtown marina development are also occurring in Oregon. The Portland South Downtown project is a shining example of that, where a marina of 250 to 300 mooring slips is proposed as a major amenity for a large $70 million redevelopment project on the downtown Portland Willamette River waterfront. In Washington, the Seattle Seacrest Marina, a proposed 600-moorage slip facility, although in west Seattle, will complement the activities in downtown Seattle.

4. Marinas are becoming harder to develop and more expensive. Governmentally developed marinas are being required to provide more public access (such items as pedestrian paths and bicycle paths), open space and general recreation and environmental programs such as marsh restoration and intertidal pool development. Inflation is impacting the cost of marina development. In addition to inflation, regulatory agencies have been and still are very restrictive on marina development, particularly where any project is to occur on wetlands or environmentally sensitive areas. In California local restrictions are brought about by the California Coastal Commission and the Bay Conservation and Development Commission (BCDC). In Oregon the primary regulator of waterfront development, particularly on the Oregon coast, is the Land Conservation and Development Commission (LCDC). In the State of Washington the State Shoreline Management Act provides strict control on waterfront development. These state and local regulators are amply aided by the federal government through the Fish and Wildlife Service of the Department of the Interior and the U.S. Army Corps of Engineers through its regulatory functions. Marinas are unique as governmental projects in that they historically pay their own way, more than most governmental-sponsored projects.

BASIC ECONOMIC CONSIDERATIONS INVOLVED WITH FINANCING MARINAS

The economics of marinas start with the supply-demand relationship. Demand is relatively strong in each of the major boating areas in the three West Coast states. Because of the high cost of marina construction and the difficulties in building wet storage, slips are generally becoming larger. The smaller berths are giving way to dry-stack storage particularly for power boats up to 25 feet in

length. An example of this is the City of Long Beach is planning a 350-unit dry stack storage facility on their downtown waterfront. A project at South Beach Marina in Newport, Oregon on the central coast is in the final phase of planning. This will be a 150-unit three-high dry stack storage building at that major marina project.

Berthing rates in response to this heavy excess in demand over supply are increasing in most West Coast market areas. In Southern California, for example, berth rates are commonly in the $4.00 to $5.00 per linear foot per month range. A new project in Huntington Harbour, a 260-berth facility called Peter's Landing, for which we did all of the market and financial planning, has been leasing slips for 6 months. They are now 90 percent filled, their basic berth rate $6.00 per linear foot per month with an end tie rate of $7.00 per linear foot per month. Berthing rates are also increasing in Oregon, particularly on the Oregon coast where we find rates of $2.50 to $3.00. For some reason berth rates in the Portland area still range from $1.50 to $2.00 per linear foot per month but we anticipate this to increase with increased demand. In the San Francisco Bay Area new private facilities command from $3.25 to $3.50 per linear foot per month. In the Seattle area of Puget Sound new private facilities command a linear foot moorage rate of $3.00 to $3.50 per month.

Operating expenses in the marinas are not increasing as rapidly as berth rates but capital cost and the cost of money is causing a continually growing problem. Whether a marina is financed by government or by private enterprise, the important element in marina economics is the size and stability of net income available to service debt and the amount of the debt service.

HISTORIC SOURCES OF FUNDING MARINAS AND TRENDS IN THE PACIFIC COAST STATES

Each of the three Pacific Coast states I have been discussing have historically used different means of financing capital costs of marina projects. In Washington the majority of marinas are privately funded. These are, however, generally smaller and located in protected areas. The larger marinas requiring breakwaters are normally funded by government. Most governmentally developed marinas have been funded by public port districts with their primary source of funding being revenue bonds supplemented by U.S. Army Corps of Engineers assistance. An exception to this for a major marina in Washington State is the new 1,000-slip moorage, Point Roberts Marina. This project, which was developed entirely by private enterprise, is unfortunately one of the few marinas that I know of on the Pacific Coast which has gone into bankruptcy. In Washington the new trend in funding is the introduction of private leasing of land and water area comparable to the policies and procedures used in Southern California for many years.

In Oregon, here again most of the marinas are privately financed with the exception of the coastal harbors (most of these are for commercial fishing boats). Most harbors in the state require minimal protection except for those on the Pacific Ocean. The newest marina in the state and the largest is the Port of Newport's South Beach Marina. The financing for this project's capital cost is indeed unique. The total of government cost of the project is $11 million, $5.7 million or 52 percent of which will be coming from the U.S. Army Corps of Engineers and a rather new source of coastal marina funding, the U.S. Department of Agriculture, Soil Conservation Service. The remaining $5.3 million will be raised by the Port of Newport through the issuance of general obligation and revenue bonds. This $5.3 million in bonds will be purchased by the U.S. Department of Agriculture, Farmers Home Administration (FmHA) on 30-year, 5 percent interest community facility loans. In Portland, the South Downtown Waterfront project will use tax increment revenue under the very successful city redevelopment project.

Now turning to California, here again most of the marinas in the state are privately financed. Exceptions to this are marinas along the Pacific Coast, and in exposed areas of San Francisco Bay. The State of California for the past 21 years has had a unique funding program under its Boating and Waterways Department. During this period the state has loaned a total of $78 million (an average of $3.7 million per year) to local cities, counties, and districts capable of constructing and operating small craft harbors. This is indeed a unique program, one without rival nationwide. The Cal Boating program has been supplemented through the use of general and revenue bonds. For example, the primary source of government funding for Marina del Rey by Los Angeles County is $13 million in revenue bonds. Revenue bonds were also used to finance Redondo Beach King Harbor and are proposed as a primary source of funding for the proposed 1,700-slip Long Beach Downtown Marina. General obligation bonds have been used to finance Mission Bay in San Diego and the marinas therein have been developed by private enterprise on land and water leases.

California has also used special districts with tax levy powers (port, harbor and small craft harbor districts) to provide funds for the capital financing of marina projects. A good example of this is Dana Point Harbor in Orange County, a project sponsored by the Orange County Harbors, Beaches and Park District using their tax levy power of 20¢ per $100 assessed valuation. In Northern San Diego County the Oceanside small craft harbor district (the only one of its kind in the state) has used bonds and/or tax levy power to aid in development of the Oceanside Harbor, a project containing 800 boat slips. Another example of a special district aiding in the development of a harbor is the Santa Cruz Port District's Santa Cruz Harbor in Monterey.

In addition, the major ports in the state have and plan to use surplus revenues generated from their other activities to aid in the capital funding of marinas. A good example of this is the marinas developed by the San Diego Unified Port District in San Diego Bay. The infrastructure and protective works for these marinas were developed by the Port District and then ground and water leases were granted to private enterprise to actually build and operate the docks.

CHANGES FORECAST FOR MARINA DEVELOPMENT IN THE PACIFIC COAST STATES

In my work as an economic and financial consultant to marinas, I have developed over the years certain forecasts which I think are appropriate to bring to the attention of this group today. Let me present my forecast for each of the three Pacific Coast states. Let's start with Washington State. As far as Washington State marina development is concerned, I see the continued use of revenue bonds in conjunction with federal aid under primarily the U.S. Army Corps of Engineers as being the primary sources of governmental finance for marinas. I see; however, more leasing of land and water areas by private enterprise within governmentally financed large marinas similar to the pattern that has existed for the last 20 years in Southern California. Further in Washington State, I see more mixed-use land-side development, particularly of a commercial nature. I see a move away from the stereotyped Puget Sound governmentally-sponsored marina parking lot for boats to mixed-use developments complementing the marina to a greater degree than in the past. Along with these trends I see higher slip rates being asked and received by marina developers in the Puget Sound area and an adjustment on the part of the public port districts to better attune their slip rates to regional market demand as opposed to continuation of unwarranted subsidy by low rates in that area. I further see the move away from the traditional covered wet moorage that has typified marina development in the Puget Sound-Seattle area for many, many years.

Now let's move on to Oregon. Here I see more marina development in the Portland metropolitan area to meet an obvious growing demand. This development will be encouraged by a historically recalcitrant local government. I even project that the Port of Portland may get into the marina development business. They have been extremely reluctant to do so over the years. In the Portland metropolitan area now the City of Portland is sponsoring the South Downtown Waterfront project at another marina development at St. John's on the Williamette River in Portland. I see, as in the case of Washington State, more mixed-use development on the shore-side portion of marinas in the State of Oregon. An example of this is the South Beach Marina in Newport on the central Oregon coast. I see a move to higher slip rates occurring in Oregon marinas to offset the increasing cost of development and operations.

Now lastly let's return to California. Here the picture isn't as bright, in my opinion, as in our sister West Coast states to the north. I forecast less use of California Department of Boating and Waterways small craft harbor construction loans for marginal projects. This will be particularly hard-felt on the North Coast of California and in the San Francisco Bay Area, particularly by city marina developers. I look for a continued development of marinas in San Diego Bay and behind the Los Angeles - Long Beach breakwater in the Los Angeles - Long Beach area. Projects here will be aided by the use of surplus port revenues and through revenue bond financing. I see a dramatic lack of further development in the more remote coastal areas for projects which over the years have been very successfully aided by loans from the Cal Boating program. For example, I would dare say that further development in Monterey Bay and on the California North Coast would come to a standstill. I look further for a general slowdown in marina development in California except in areas of extremely heavy demand. Lastly, slip rates are bound to increase even more than has been experienced in the heavy demand areas of the state. Personally, I don't know where they are going to stop in Southern California. Additionally and lastly, I see more use of stacked dry boat storage for power boats up to 25 feet in length, particularly in Southern California. This has already been borne out by projects that I have mentioned here today. I hope that in this short period of time I have been able to successfully present to you a once-over-lightly on the economics of marina financing in the Pacific Coast states.

LEASE OPTIONS FOR MARINA DEVELOPMENT

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Recreational small craft harbor development on the California coast has changed considerably over the last few years. Beginning with bare moorings and scruffy, slapped-together piers and docks in the back corners of already existing harbors, we now have well-planned, large developments with first class construction and supporting land facilities. This trend began to be seen shortly after the end of World War II and several thousand boat slips with supporting land development have been constructed and opened to the public since that time.

Marina construction in the beginning of this period was normally done by a public agency with ownership of and jurisdiction over the harbor area and the private sector was limited to the development of minor supporting landside facilities. Some marinas were developed privately but these were generally not the quality of construction which the public agencies were creating in various projects. This trend changed in the early Fifties when the private sector was offered the opportunity to develop full marina facilities through the use of the long-term ground lease. What has resulted is a unique partnership between public agencies as the landlord, and the private sector as the developer and provider of this service to the public. While there was precedent for this type of development in other parts of the country, such as Fort Lauderdale, Florida, California harbor agencies have maximized the use of this type of real estate transaction to provide facilities for the fast growing recreation boating field.

As in any other types of development financing, a great deal of experimentation has occurred in coastal projects, and a number of methods have been used to provide new marina facilities. Through the use of the long-term ground lease, private investments ranging from $2 or $3 million to as high as $150 million in the monster project known as, Marina del Rey, have been made in providing such facilities.

The most satisfactory method found to date is called the Lease Option. This simply means that the long-term lease for development has been combined with the use of the option at the beginning of the process and answers a number of problems which had been emerging with the single lease as the controlling document.

In the earlier years, it was thought that the agreement between the developer and the owner of the land and water area, was sufficient to include all terms and conditions for the provision of the facilities. Experience showed, however, that the actions and obligations required of the lessee during the first year or two of the lease period, were different than those obtained after financing was acquired and the facilities were built. The differences lay principally in the requirements on planning, obtaining permits and all other approvals to go ahead, and acquiring not only the construction financing, but the take-out financing covering the permanent economic life of the improvements built. The highest incidence of failure of these lease programs could be traced to the difficulties encountered by lessees in this start-up period. The only cure for the lessor lay in the process for cancellation provided in the lease.

It became obvious that something else was needed and the theory of the option-to-lease was conceived. Option is defined as, "A stipulated privilege of buying or selling a stated property, security or commodity at a given price within a given time." It is further defined as, "The exercise of the power of choice." The option as a device in a real estate transaction is classical and is as old as the human experience in exchange of title for property. The concept of the power of choice is critical in the use of the option method in a lease. The Orange County Department of Real Property Services with the assistance of Williams - Kuebelbeck and Associates authored the first workable instruments to accomplish the solutions to the problems mentioned in the above paragraph. What it did was to provide a period during which a prospective lessee would perform all of the early planning, permit approval, financing requirements for the development; and, once this was done satisfactorily, would have the right to exercise an option for a long-term lease. What, in effect happened, was that all of the problem areas in the early period of the standard lease term would be removed as conditions in the lease and placed under a separate instrument known as the Option to Lease. The Optionee under this method would have the right to a long-term lease only if he satisfactorily completed his planning, obtained his permits and other approvals, and provided satisfactory evidence of long-term financing.

As Optionee, if he failed to meet these requirements, he simply lost the right to a long-term lease and a moderate expenditure of his option price and whatever funds he had invested in the planning phases. The Optionor had the obligation to remove his land from the market for only a short period of time and the opportunity to gauge the ability of the prospective lessee to perform. If the lessee failed during the option period, the optionor was then free to seek other individuals who could meet his requirements for provision of the facilities.

It was not necessary for him to bring actions in default against a failing lessee, and take the long and arduous course of attempting cancellation of a long-term lease. Overall, the lease option has solved a number of problems both for lessor and lessee, and has made it possible to accelerate the rate of development under such lease arrangements.

How does the option method actually work? The lessor prepares his offering in two distinct phases. One is the long-term lease itself which contains all terms and conditions for the construction and operation of facilities on lease-hold property over the long-term period. This document contains all the standard provisions for construction, operation, payment of rent, penalties for non-performance, rights to assign, insurance requirements, and all other provisions normally found in this type of real estate transaction.

The second instrument is the Option-To-Lease which contains the planning requirements, in detail, from conceptual planning through the completion of working drawings. It also contains, in detail, the permits and approvals required and the steps to be taken to acquire them. This is particularly important in view of the extensive environmental controls which exist in today's world. It finally requires the firm commitment for both construction and take-out financing and the posting of all necessary bonds, security deposits, certificates of insurance and other financial requirements showing the developer's ability to perform, as well as his financial staying power.

The option becomes the point in the process where selection of the developer takes place. Requests for proposal are built around the Option-To-Lease rather than the lease alone. Typical options utilize the option price, which is set in relation to land value, as the minimum price to be paid for the right. A bonus bid is then solicited as part of the proposal. Requests for proposal are put out, into the market and a number of criteria are established for choosing the best optionee. These include: experience in operation; financial background; viability of proposed plan of development; sensitivity to goals of the lessor, particularly, where a city or government agency is involved; and other factors which the lessor wishes to use as criteria for judging the proposals which are submitted. The lease form, development specifications and all other instruments of agreement are incorporated as a single package in the offering.

Depending upon the size and complexity of the development, option periods are normally 12 months in duration. Provision is normally made for extension either by request of the optionee, at an additional amount of money, or where problems occur, such as in the environmental permit process, which are beyond the control of either optionee or optionor.

Once the successful optionee has satisfied all requirements the lease can be signed and construction can start immediately. Lease terms then come into effect; but, on a going project where all of the early planning problems have been solved, and where both the lessor and lessee have become acquainted with each other and understand each other's goals and methods. The option period has provided a close working relationship whereby a true partnership in development of the lease-hold can be achieved.

The advantages of the lease option method are many. Probably the principal advantage for both parties is that a set period of time has been established during which both lessee's and lessor's ability to perform are clearly demonstrated. In the event of failure, the most the optionee can lose is the amount of option price he paid and any costs of planning and time spent on the project which he has invested. From the standpoint of the lessor he is free to seek other developers since the option conferred no interest in property, but only the right to a lease if all requirements were met. Time, obviously, would be lost on the part of both parties; however, experience with efforts to terminate bad leases clearly indicates that time lost in a stated option period is far less.

The owner of the land is also in a much better position to control the nature of the development because the rules are more specifically laid out in an option than in a lease and particularly the time factor is to his advantage. There can be no argument about the date on which the option terminates and this is an advantage to both parties.

The definiteness and certainty of the option terms can also be an advantage to the optionee in arranging his financing. Many lenders still are not favorable to financing lease-hold development, as compared to development on fee-land. The requirement for all planning and permit processes in the option therefore puts the optionee in a better position with the lender because the total project is laid out and ready to go for a firm loan commitment. This is particularly important in current inflationary times when time is of the essence in the face of increasing interest rates for loan funds in all types of development.

The lease option has proved to be an extremely useful tool to owners of land on the California coastline, for lease-hold development of marina facilities with the private sector. Undoubtedly there will be disadvantages and problems discovered with the use of the method over the next few years just as there has been with the lease itself. These will be corrected by knowledgeable people in the real estate field just as the method itself was developed. Overall, it has proved a substantial improvement in the development of property through the lease method as a reliable and flexible real estate transaction.

OPERATION AND MANAGEMENT OF A SPECIAL DISTRICT

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It gives me great pleasure to address the members of this audience. I am sure that the things we learn during this conference through the exchange of ideas and sharing of knowledge acquired from each of our fields of endeavor will provide us all with a valuable resource for use in the future.

Special districts are nothing new in the United States. Problems associated with water rights and distribution in the 1800's caused formation of early districts. As of the 1972 census of governments, there were 23,885 special districts throughout the United States. In California alone, excluding school districts, there are 4,235. There are more special districts than any other type of government unit.

The San Mateo County Harbor District was formed in 1933 to develop a harbor on Redwood Creek known as "San Mateo County Harbor No. 1 on Redwood Creek." Boundaries of the new district were established so as "to embrace the entire area of the County of San Mateo." A special election was held on the 27th of June 1933, and so another special district came into being.

When the District was unable to obtain funding for the Redwood Creek Project, it became dormant and remained so from 1935 to 1948. The United States Congress in 1948 approved Public Law 848, Rivers and Harbors Act, authorizing expenditures of approximately $5,000,000 for breakwater construction at Pillar Point Harbor. It was stipulated in the law that "local interest establish a competent and properly constituted public body empowered to administer the harbor facilities." This body was also required to give assurances of compliance with conditions imposed on the project, including a requirement to provide and maintain necessary mooring facilities, public landings, supply facilities and easements for ingress and egress for construction and maintenance of the breakwaters. You have probably guessed by now that the competent, properly constituted, public body was the San Mateo County Harbor District.

You will remember that the District was initially created to develop Redwood Creek. Because of the change in harbor location in 1959, it became necessary to amend the Harbors and Navigation Code to authorize the District to acquire, construct, own, operate, control or develop harbor works or facilities within its physical boundaries which are the same as San Mateo County. Additionally, the District has broad powers related to harbor development and operation which include: the acquisition and operation of warehouses, grain elevators, bunkering facilities, belt line railroads and other harbor-related facilities. The District has powers of eminent domain, may issue general or revenue bonds, borrow money and perform other governmental functions to accomplish its basic purposes. It is governed by an elected board of five harbor commissioners.

Funds were appropriated in 1959 to construct breakwaters at Pillar Point Harbor. By June of 1961, the breakwaters were completed. In 1962 the District had completed construction of a public pier, restroom, concession building, fish receiving facilities and harbor master building. Surge conditions within the Harbor have frustrated attempts to construct boat slips until this day, despite the fact that a "dog leg" was added to the west breakwater to correct the surge.

The Harbor District has attempted to develop Pillar Point Harbor and establish itself as a county-wide agency in spite of political and environmental opposition, restraints on harbor and marina development imposed by various regulatory agencies such as: the California Coastal Zone Conservation Commission, Bay Conservation and Development Commission, Regional Water Quality Control Board and the Army Corps of Engineers.

On November 11, 1977, the District assumed operational control of the Oyster Point Marina from the City of South San Francisco under the terms of a joint powers agreement with an effective term of 50 years. Construction of expanded boating facilities and related shoreside facilities for Oyster Point then became the responsibility of the Harbor District.

Perhaps, at this point, it would be helpful if I outlined the existing facilities at the two harbors operated by the Harbor District, then discussed the development plan for each.

PILLAR POINT HARBOR

This commercial fishing/recreational boating harbor provides a refuge for approximately 100 commercial fishing boats and 100 pleasure crafts. Limited tie-ups are available at the Johnson Pier for loading and unloading boats and, in some cases, overnight accommodation. Power and water are available in addition to fuel and ice. Most of the vessels are moored in the open water area of the Harbor inside of the breakwater. Shoreside facilities include: a concession building housing two coffee shops,

two bait and tackle shops, and a retail fish market; a harbor master office, warehouse, public restroom and shower, a single-lane launch ramp, recreational vehicle overnight parking area and automobile parking areas for 400 cars. Approximately 36,500 people visited the harbor in 1979. The harbor patrol responded to 98 calls for assistance in the harbor vicinity.

Expansion plans for Pillar Point Harbor, for which all necessary permits have been obtained, will provide these additional facilities: an internal mound rubble breakwater system to eliminate a severe surge problem, 220 commercial fishing boat slips, 220 recreational boat slips, a three-lane launch ramp, a boat repair facility, a chandlery, a medium-sized, 8,000 sq. ft. restaurant, and a fish processing facility. The total estimated construction cost of the project not including lessee construction is 10.9 million dollars. Funding of the project will be accomplished with a 4.1 million dollar California Boating and Waterways Department loan, District tax revenues and Federal funds.

OYSTER POINT MARINA/PARK

Located in the City of South San Francisco, this primarily recreational marina provides direct access to San Francisco Bay and contains the following features: 294 boat slips, a yacht club, harbor master's office, boat storage, boat launching facilities, a fuel dock and automobile parking areas.

Plans for expansion of this marina, when completed, will provide a full-service public recreational area containing an additional 300 boat slips and the following shoreside facilities: a boat launching facility, a fishing pier, expanded yacht club facilities, two dinner restaurants, a coffee shop, boat sales, chandlery, boat repair and haul out, a harbor office building for District Administration and Harbor Master, a boatel and an office building. Expansion of the Oyster Point facility will cost an estimated $12,000,000. This high cost is directly related to solving a pollution problem originating from the garbage fill which created the site and the effects of recent economic trends.

The five elected harbor commissioners are responsible for management and control of the improvements, development, protection and maintenance of the Harbor District. District staff includes a general manager and an executive secretary. Day-to-day administration and property management functions of the District are the primary responsibilities of these two people. Operation and maintenance of harbor facilities are the responsibility of the harbor master assigned. Technical assistance is provided to the staff through a retained accounting firm, legal counsel and an engineer.

Oyster Point is an economically self-sustaining unit at the present time and will continue to be so after development. Pillar Point Harbor, however, is another matter. Operating costs have always exceeded operating income, thereby creating a need for tax subsidized operations. There are many reasons for this situation. Among these are allowing use of District facilities without imposition of charges, substandard rents and provision of a level of service above that suggested by operating incomes. Sound management practices instituted after 1976 have increased operating revenues over 600%. Additional improvements in the leasing program yet to be implemented will bring operations into the black by fiscal year 1980-81. All tax monies will then be used for capital construction projects.

Full development of the Pillar Point and Oyster Point projects will provide approximately 750 new boat slips to the market area within the next two to three years which will satisfy boat owner needs. Services and facilities for the use and enjoyment of the general public will be provided. Local employment opportunities will be available to county residents. Commercial fishing operations will be enhanced by adequate mooring and ancillary shore support facilities. Tax support for boating facilities will no longer be necessary in San Mateo County because both District projects will be self-sustaining.

DESIGN CONSIDERATIONS FOR NORTHERN MARINAS

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INTRODUCTION

Harbor structures in Great Lakes and other northern areas are damaged by ice. The winter regimes are hostile environments challenging the technical abilities of marine engineers and contractors. This paper presents information for the small-craft harbor designer and builder. The recommendations are supported by winter observations in two hundred United States and Canadian harbors, together with field and laboratory tests, literature searches, and personal design experiences.

Ice for purposes of this paper is primarily stationary lake ice. River ice, ice floes and sea ice are not specifically dealt with. They may present additional and somewhat different problems. Small-craft harbors are customarily built in sheltered areas away from moving ice masses. From a structural design standpoint, brackish and sea ice in small-craft harbors should present problems no worse than those associated with sound lake ice.

More information about ice engineering in small-craft harbors is given in an advisory report (1). This report is comprehensive and has served in part as a source for this paper. The report also deals with other related topics such as the ability of ice to support construction loads.

ICE AND ICE COVERS

Ice, a visco-elastic material, exists in nature in a relatively high temperature state, i.e. near its melting point. The mechanical properties and strengths of ice vary over wide ranges. The values depend on the temperature of the ice, the rates and direction of loading, the composition of the ice, and other factors. Precise values are therefore not available to the designer, and engineering judgment must be used.

Ice forms in a lake and small-craft harbor by atmospheric cooling of the water. First the water surface is cooled to 39°F, the temperature at which water is in its most dense state. This dense water sinks forcing up less dense water. This process continues until the lake has "turned-over" and is isothermal at 39°F. From this point on the surface cools until ice begins to form at 32°F.

If the water conditions are calm, dendritic ice crystals will extend across the surface. However, if windier conditions exist, fine grained congealed slush ice will form. Once a cover has been established, the ice will grow down into the water as heat is extracted. In very cool weather the growth of ice is rapid. Air will be entrapped and give the ice a milky or white appearance. If the ice has formed slowly, it will be transparent and stronger. This ice is referred to as black or clear ice.

Additional ice forms on top of an ice cover from snow that has turned to ice. This is a metamorphic process or a freezing of snow that has become wet. This ice is granular and can be quite strong.

A cross section through an ice sheet can yield highly variable conditions depending on how the ice was formed and its age. Entrapped water may even be encountered.

In the Great Lakes a stable appearing ice cover can be as thin as two inches. Thicknesses of more than four and a half feet have been measured in shaded areas under pile supported docks. Selecting a thickness for design depends on the location of the harbor, the conditions being designed for, and the importance of the structure. (Under some design conditions, the thicknesses of the ice are not particularly important.) Thicknesses of 3 feet can be expected in the Great Lakes.

Water temperatures in Great Lakes marinas are near the melting point of ice. The boat harbors are isothermal with depth with no discernable 39°F bottom waters. Values above 32 1/2°F are rare and when they exist may be only temporary.

Ice leaves harbors during the winter. Storms, accompanied by strong winds, break the ice cover and "blow" the harbor clear. (Figure 1.) As a result docks are impacted by large chunks of ice. Also a harbor cleared of ice may have thin unstable new ice formed in mid-winter.

Ice in the Great Lakes and its harbors osciliates from a phenomenon known as seiche. A seiche is a short-term rise and fall of the water level and is caused by either persistent, strong winds piling up the water at one end of a basin, or changes in barometric pressure over the lake, and sometimes a combination of both. The period of a seiche is a few minutes in a bay or harbor and about ten hours for a Great Lake. Winter water level changes of 3 inches in 10 minutes are common. Very large winter seiches have occurred causing the water level to drop. The no longer buoyant ice imparts downward loads to the pilings driving them further into the bottom.

Figure 1. Ice Cover Being Blown Out of Harbor

Figure 4 shows lateral displacement of a dock. Also, note the pilings that have been lifted.

ICE SUPPRESSION WITH COMPRESSED AIR

A trial and error design procedure for ice suppression with compressed air is presented below. This procedure removes the ice and its harmful effects on dock structures. Ashton's monograph (2) has been used as the analytic model and adapted for man-made small-craft harbors. Figure 5 is a cross sectional view along the axis of an air diffuser pipe on a harbor bottom. It is also representative of

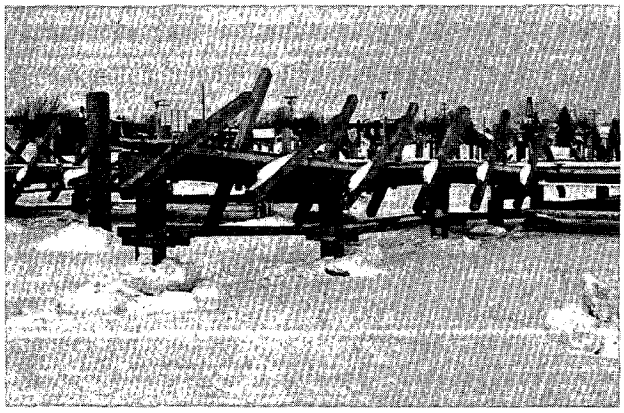

Figure 3. Steel Dock Uplifted by Ice Seiche Action

The ice melting that occurs on the underside of the sheet is the result of both temperature and volume of water being moved upwards from the warmer bottom water by the bubble plume. If the plume encounters a free water surface, the bubbles escape directly to the atmosphere. (Figure 6). This results in heat being wasted. If an ice cover exists, the bubbles will move laterally along the underside of the ice. As they do, melting primarily by convection occurs. The rising plume imposes a net circulation on the water which allows more warm water to be drawn into the area from distant lateral directions.

When the water (and ice) rises, either the piles embedded therein, are pulled from the bottom or the ice slips or fails near the piling. If the pile is lifted, the soil at the tip of the pile sloughs into the void created. When the lake level recedes, the piling cannot return to its former depth. The ice eventually breaks away from the piling, drops, and refreezes at a lower level to the "jacked" pile. Piles may be jacked completely out of the bottom by seiche action. Figures 2 and 3 show piles jacked by seiche action.

Stationary ice responds thermally to temperature changes. The expansion and contraction exert lateral force on pilings, cribs, dock floats, and anything else embedded in the ice cover.

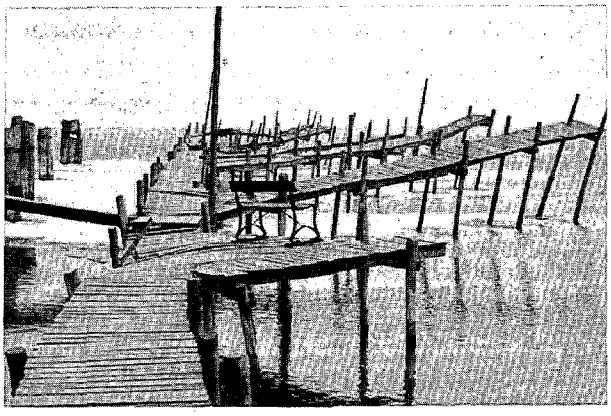

Figure 2. Wood Dock Uplifted by Ice Seiche Action

a series of point source diffusers that would be used to suppress ice around a line of single pilings.

Air is compressed, usually with a low pressure positive displacement blower, and distributed through a manifold line to diffuser lines on the bottom. The compressed air is discharged through slits or orifices in the diffuser lines. The momentum of the air jet sets air bubbles in motion. This momentum quickly dissipates and bubble buoyancy takes over. As the bubbles rise, they entrain water into the rising plume.

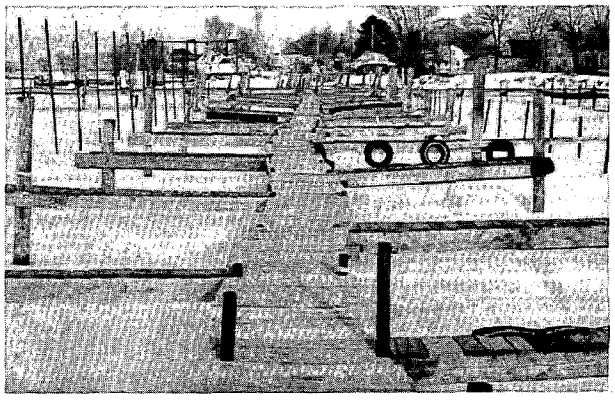

Figure 4. Lateral Displacement of Boat Docks

For a given site and conditions, the quantity of air required, Q_a, is estimated for a tolerated ice equilibrium thickness, n_e. The air pressure need only be sufficient to overcome hydrostatic head, and distribution and diffuser losses. At the tolerated ice equilibrium thickness, the ice is melting as fast as it forms. The selection of this thickness should be based on first cost and operating costs, resistance available to ice uplift through embedment of piles being protected, magnitude of lateral forces from thicknesses of ice, availability of manpower to chop ice during severe cold periods, temperature extremes existing at the site, and the amount of damage to be tolerated.

The quantity of air required Q_a is estimated from experience. Table 1 gives heat transfer coefficients, h_b, as a function of water depth, H, and Q_a.

Table 1. Heat Transfer Coefficients, h_b Btu/hr ft^2 F

Water Depth, H	Air Flow Rate Per 100 ft. of Diffuser, Q_a		
	2 cfm	4 cfm	6 cfm
6 ft	169	189	201
10 ft	150	167	178
14 ft	135	151	162

The heat transfer rate, q_w, is obtained from:

$$q_w = h_b (T_w - T_m)$$

where T_w is the water temperature and T_m is the melting point temperature of ice.

Table 2 gives the equilibrium thicknesses n_e for the calculated heat transfer rate q_w as functions of the ambient air temperature T_a. Because warmer day temperatures counteract cooler evening temperatures, the average daily temperature can be used for T_a. Table 2 assumes no snow cover on the ice and 10 mph winds. If a snow cover is present, the equilibrium thicknesses become smaller for a given q_w ; and conversely, if windier conditions prevail, the equilibrium thicknesses increase.

Table 2. Ice Equilibrium Thicknesses, n_e inches

Required Heat Transfer Rate, q_w Btu/hr ft^2	Ambient Air Temperature, T_a				
	20°F	10°F	0°F	-10°F	-20°F
25	4	10	16	16+	16+
50	1	3	6	10	13
75	--	1	3	5	7
100	--	--	2	3	5
125	--	--	1	2	3

The use of Table 1 and Table 2 is illustrated by the following example:

Assume Q_a, quantity of air = 6 cfm/100 ft.
H, water depth = 10 ft.
T_w, water temperature = 32.5°F
T_a, air temperature = -10°F

from Table 1 at Q_a = 6 cfm/100 ft. and H = 10 ft.
find h_b = 178 Btu/hr ft^2 F

from $q_w = h_b (T_w - T_m)$
at h_b = 178, T_w = 32.5, and T_m = 32
find q_w = (178) (32.5 - 32)
= 89 Btu/hr ft^2

from Table 2 at q_w = 89 and T_a = -10°
estimate ice equilibrium thickness, n_e = 4 inches

For the conditions assumed, the ice would maintain an average thickness of 4 inches. Colder weather would increase the thickness, and more air would reduce the thickness or cause open water. Observations in the Great Lakes show that compressed air ice suppression systems are very effective in protecting small-craft harbor structures. Careful maintenance of these systems is essential.

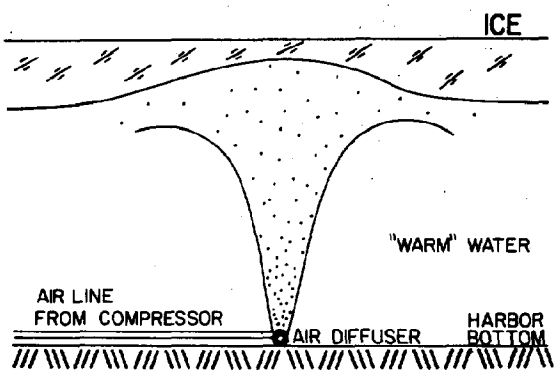

Figure 5. Compressed Air Ice Suppression System

need to offer the same resistance as would be required of a bridge pier exposed to floes in a river. Additionally, codes are now permitting significant reductions in the design force to be used on river piers. These reductions, based on experience, depend on the type of ice, the size of the pieces and other factors.

Based on observations of piling supported boat docks in protected harbors, where blocks of ice move about and perhaps are even blown out of the harbors, design loads are significantly less than the crushing strength of ice. The blocks of ice result from a stable cover

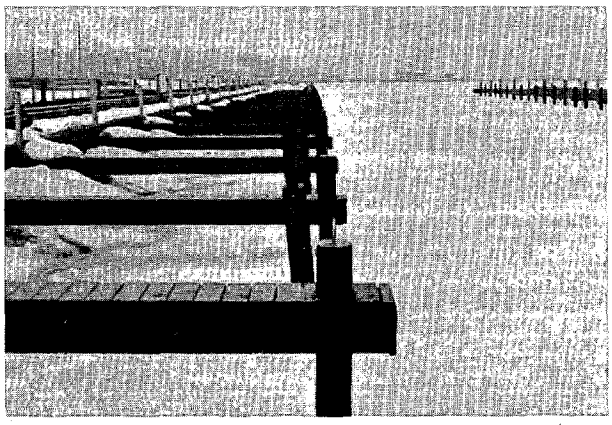

Figure 7. Free Standing Mooring Pilings Permanently Deflected by Ice

thermal cracks will relieve horizontal forces. When an ice sheet warms up, expansion will shove pilings and cribs about. Methods to estimate, or measured values for these thermal thrusts on individual pilings, have not been published. From observations on boat harbors in the Great Lakes, these forces are less than mooring forces for which the docks have been designed. However, the deflection of dock supporting flexible pilings will be a matter of inches and adequate allowance in all structural connections must be provided. Free standing mooring pilings may be permanently deflected, especially if they are located in a harbor basin with confining vertical sheet pile bulkheading. (Figure 7.)

DESIGN FOR HORIZONTAL FORCES

Small-craft harbors not protected with ice suppression systems must be designed to withstand horizontal and vertical forces. At this time, we can only approximate these forces. Ways to reduce forces, for example, coating systems with epoxies, are being explored by the US Army Corps of Engineers Cold Regions Research and Engineering Laboratory (CRREL) and others. Results are not yet available.

Horizontal pressures of 400 pounds per square inch, representative of the crushing strength of ice, have been used for pier design. Small-craft harbors are built in sheltered areas not subject to ice floes. They therefore do not

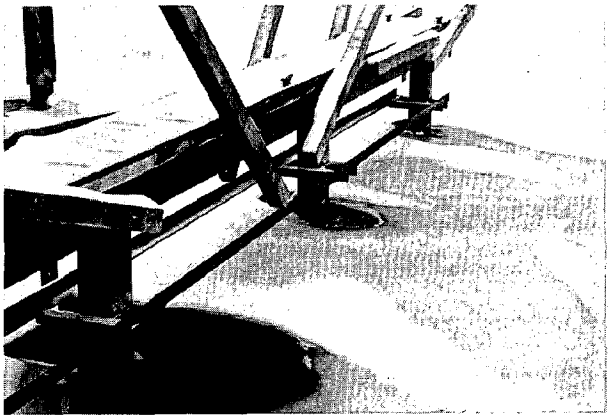

Figure 6. Ice Suppression and Melting Around Steel Dock

breaking up under wind and surge, and not from a sustained ice floe. The blocks of ice exert impact loads on supporting pilings or dock cribs but do not crush on them. Because horizontal forces from moving pieces have not exceeded the mooring forces for which the docks were designed, no special design analysis is recommended as necessary in a conventional boat harbor. Some minor damage to dock members that are impacted by moving ice pieces should be expected.

Where a stable ice cover exists, it will respond thermally to changes in temperature. During cold spells, ice contraction will occur and many

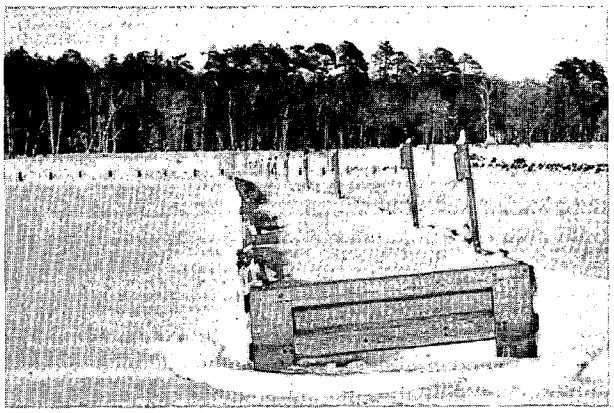

Figure 8. Crib Structure Deflected by Ice

Crib structures will experience lateral shoving and must be designed to withstand the thermal forces. (Figure 8.) Recent comprehensive laboratory studies by Drouin and Michel (3) have measured values for these factors. Although the work is a laboratory study, it is pertinent to the boat harbor designer.

Because of cracks, faults and discontinuities, field ice will be weaker than laboratory ice. Additionally, any snow on the ice will reduce the thermal responsiveness of the sheet. Thin ice is not capable of exerting significant thrusts. It buckles first. Thick ice tends to be self-insulating, i.e. the effects of a sustained temperature rise are rapidly attenuated with depth in the sheet. Therefore, thickness of the ice is not a critical factor in estimating thermal forces.

For the above reasons and based on observations of cribs in the Great Lakes, a design value of 10,000 pounds per foot is recommended for thermal thrust on gravity type crib structures. Values one-half as much would be appropriate in areas with large snowfalls or weak unsound ice. On the other hand, 20,000 pounds per foot would be an appropriate estimate for clear ice, in a very confined boat harbor (without sloping banks) and under an unusually warm period following very cold weather. The importance of the structure to the overall project would also be a factor in selecting the design values.

Dock pontoons embedded in ice may be squeezed out of the ice, or equally often, be drawn into the ice. For a series of connected dock floats contortions of two feet throughout the dock have been observed. (Figure 9.) Connections and dock members must allow for these movements. The floating docks must be free to move laterally without binding on pilings, and without restraint from shore attachments. A dock frozen in ice and to a piling that begins to be "jacked" by the ice sheet will literally be torn apart by tension on the horizontal plane of the dock. In the spring, docks attached to shore are damaged when the ice sheet melts free from the shore and moves about under wind action.

Values for squeezing forces on dock floats left in the ice have not been determined. Field studies are underway but results are not yet available. Although most Great Lakes marinas remove floating dockages for the winter, some do not; and the floats appear to be withstanding the squeezing ice pressures. However, some corner pinching and dimpling on floatation encasement shells are occurring.

DESIGN FOR VERTICAL FORCES

In a marina, pilings and other structures frozen into the ice cover will experience vertical forces from water level fluctuations. The case of most concern is a water level rise which lifts pilings from the bottom causing great damage. (Figure 10.)

However, when large water level drops occur, the ice loses all buoyancy and becomes a hanging dead weight spanning between "supporting pilings". Pilings should be designed for this full dead weight applied as an ultimate load. The maximum density of ice is 57 pounds per cubic foot.

Estimates of minimum ice uplift loads can be derived theoretically from a first crack elastic analysis of an infinite, floating, thin, homogeneous ice plate pierced by a round structure. The differential equation formulating this problem has been solved (4, 5) for boundary conditions describing a circumferential crack located a distance "a" out from the center of the piling. When an ice sheet pulls upward on a strong well embedded piling, a circumferential crack does occur. For a steel piling, this crack is usually 6 inches out from the face of the piling, and somewhat less for a wood piling. The ice is thicker next to the piling because of heat transfer through the piling. An ice collar forms around the piling.

More severe failure criteria (4) with radial cracking and additional circumferential cracking have been analyzed and give uplift loads several times greater than the first crack criterion used to estimate the minimum uplift loads shown in Table 3. This table is based on strong lake ice having a flexural strength of 200 pounds per square inch.

Table 3. Minimum Ice Sheet Uplift Loads, Pounds

Radius of Load Distribution "a"	Ice Thickness			
	12 in	18 in	24 in	30 in
6 in	8,000	16,000	28,000	44,000
12 in	10,000	20,000	33,000	52,000
18 in	12,000	22,000	38,000	56,000
24 in	14,000	25,000	44,000	64,000

The use of Table 3 is illustrated by the following example. Assume we have a 12 inch round steel pipe piling embedded in 24 inches of firm ice. The radius of load distribution "a" is equal to the radius of the piling (6") plus the radius of the ice collar (assumed to be about 6"); therefore "a" equals 12". From the table, the minimum ice sheet uplift load is 33,000 pounds.

For design, an ultimate uplift load several times greater than the Table 3 minimum should be used. It is recognized that the assumptions used to compute the minimum values do not generally fit the conditions

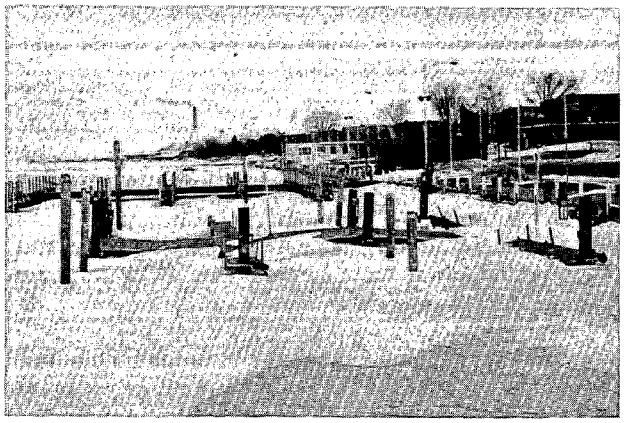

Figure 9. Contorted Floating Dock

Figure 11 shows pieces of ice that have "formed" around pilings. These pieces have been termed ice rubble.

Rubble pieces can accumulate under docks and transmit forces from fluctuating ice sheets to horizontal structural members and utilities suspended under docks. Figure 12 shows a three-inch water main bent earlier in the winter by massive rubble pieces on top of the ice sheet.

When rubble is observed, it is an indication of water level fluctuations. If the ice is slipping on a piling, there will be no rubble, but ice shavings and thin pieces of frozen water film

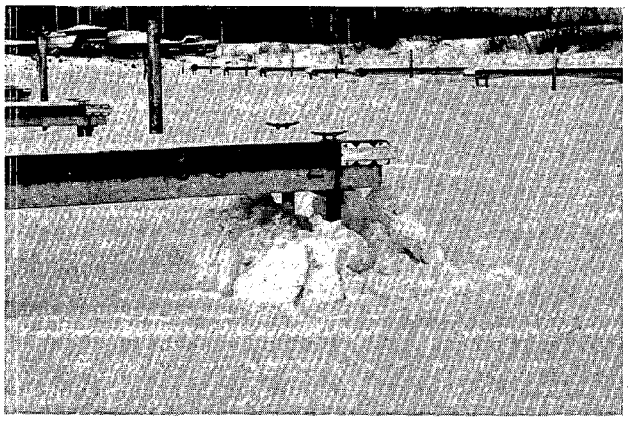

Figure 11. Ice Rubble Around Pilings

the sheet going down. When the water refreezes and the sheet again rises, these pieces get pushed up around the piling. Occasionally very thin pieces of ice, or blisters, will be formed when a sheet falls and these pieces split out. The formation of rubble can be reduced if the ice can be made to slip on the piling.

Walls and long cribs experience little damage from ice lifting. There normally is cracking parallel to the structure which reduces uplift from rigid attachment. Occasionally, however, the top of a crib will be pulled off because it was inadequately attached to the lower portion of the crib.

found in the field. For example, the ice is probably not homogeneous, may be cracked and not infinitely continuous, or may not be completely attached to the embedded piling. Notwithstanding these realities, which tend to reduce uplift loads, the theory predicts minimum values (for a first crack to occur) and larger ultimate values will occur. The values to be used will be matters of engineering judgment and the importance of the structure being designed.

Pilings near the extremities of a dock are lifted more than those nearer the center of the dockage. (Refer to Figure 3.) These pilings should be made more resistant to uplift and thereby fail the ice sheet about them. This will tend to protect the inner piles as an encircling crack may develop around the entire dock configuration.

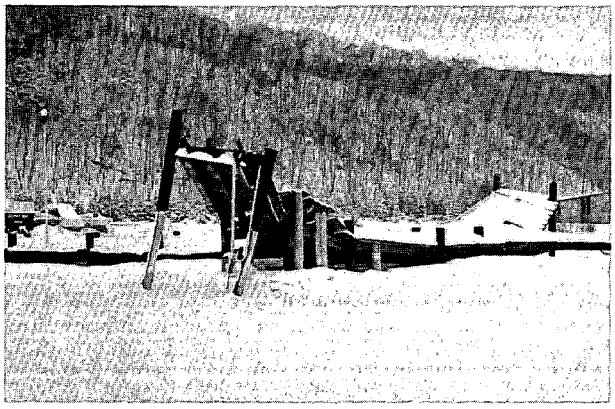

Figure 10. Dockage Lifted and Damaged by Ice

will surround the piling. If the ice is lifting or jacking a piling, there will be no rubble but rather pieces of ice, or ice rings, attached to the lifted length of the piling.

Rubble forms around pilings that are resisting uplift forces and are not being jacked from the bottom. The rubble pieces come from broken off ice collars when water levels rise and eventual refreezing to the piling occurs. Rubble is also generated when the ice sheet falls. When this happens, a piece of ice splits out of the top of the sheet. This occurs from diagonal tensile stresses produced between the top portion of the sheet frozen to the piling and the balance of

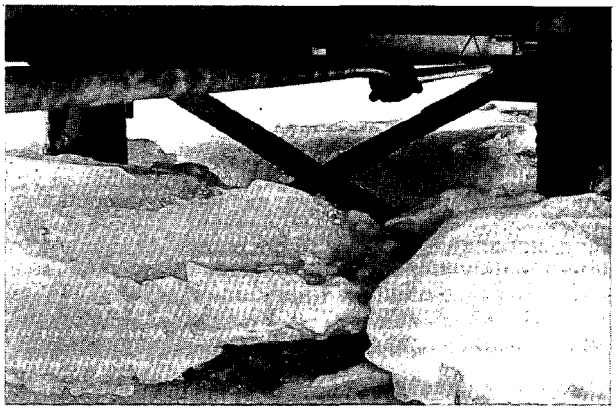

Figure 12. Under-Dock Water Main Bent by Ice Rubble Pieces

CONCLUSIONS

Compressed air ice suppression systems can be designed to eliminate ice forces. Also ice forces on structures in protected boat harbors can be estimated. Ice thickness of three feet can be expected in the Great Lakes. Water temperatures in boat harbors are isothermal with depth and are usually 32 1/2°F or less. Winter storms can blow a harbor free of ice. Lake seiches cause constant fluctuations of ice covers. The full dead weight of ice can be assumed as an ultimate load condition on pilings. Uplift forces jack pilings from the bottom. Estimated minimum value for uplift forces have been computed from a first crack elastic analysis of a floating ice plate. Lateral ice forces on pilings are believed to be less than mooring forces from wind and boat impacts. Thermal expansion forces on cribs probably range between 5,000 and 20,000 pounds per foot. For more information about ice engineering in boat harbors refer to advisory report (1).

ACKNOWLEDGMENTS

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LET'S MAKE MARINAS COST EFFECTIVE

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Redondo Beach, California

The leisure industry in the last ten years has grown, at an increasing rate, to one of the largest dollar volume industries in the country.

Millions of dollars are being poured into outstanding ski resorts, tennis clubs, bike trails, hiking trails and leisure activity centers that require the public to invest heavily in leisure products to participate. These well-planned and managed facilities attract the public to their leisure activity. This has consistently been true of ski resorts and tennis clubs, but not so with the marine industry. According to industry statistics, some 6,000 marinas exist along with an estimated 11.3 million boats nationwide. Over the years 1973-1978, the boat population increased 19.5% while the number of marinas grew only 1.2%. Zoning laws and environmental concerns have held back the building of new marinas and hampered efforts to expand existing ones. Simultaneously, an alarming number of smaller marinas cease operations each year, to be replaced by waterfront condominiums. Unless this situation is turned around now, the boating industry is going to share less and less of the total recreational dollars.

The marina industry has got a tough row to hoe since it tends to ignore some of its own potential problems:

Examples of this are as follows:

1. It can no longer go out and easily build a major small craft harbor since the environmentalist might decide it is not the highest and best use of the land.

2. Power boat manufacturers saw the marina facility crunch coming, so they encouraged the trailer manufacturers to build bigger trailers. The sailboat industry went to swing keel and center boarders, then asked the trailer manufacturers to build for these boats as well. Now, the government has asked for a fuel conservation program that in a short time will put half the potential boating public into cars that can't pull these trailers. It may come as a shock to some, but the average gross load towing capacity for U.S. models today is approximately 2,000 lbs. This is a "from the assembly line" figure, that is, before special towing or other heavy duty options have been added. By 1985, G.M. estimates that the average gross load towing capacity of its models, again from the assembly line, will be only about 1,500 pounds.

In the next six years the Federal gasoline mileage standards will compel the American auto companies to make the most drastic changes in their cars that have ever been made. These changes will occur year by year, as the mileage standards slowly tighten. They'll substantially change the vehicle size, engines, transmissions, drive trains, and materials.

To achieve the 1985 standard of 27-1/2 miles per gallon, it may be necessary to reduce the production on the most popular U.S. models on the market today -- the heavy five- and six-passenger sedans and station wagons. . . . the cars most capable of pulling a trailerable boat.

Beginning this fall, the fleet of cars offered for sale by each domestic and foreign manufacturer must average 19 miles to the gallon. This figure will climb one mile per gallon through 1980 and then it will have to be increased an average of 1-1/2 miles per gallon until the 27-1/2 mile goal is reached in 1985. Even this schedule may be moved up considerably by President Carter's energy program.

If the marina industry would look to Europe, they would see a nation with 80% of its cars incapable of towing a trailerable boat. In California, as an example of things to come, 40% of the new car registrations so far this year are small foreign cars. When you consider that 80% of the boats in the industry are under 25' in length, it is easy to envision how many people will be shut out of boating in the near future.

According to an L.A. Times survey of automobile manufacturers, distributors, dealers and industry analysts, 7 out of 10 new cars being purchased in California are compacts or sub-compacts. That's the highest mix of any state compared to the average of 5.5 sub-sizes out of 10 new cars sold nationwide.

It has been suggested that the boating industry should follow the lead of the auto industry and begin emphasizing smaller boats. At the present time, this does not seem to be a viable solution in light of the market research which indicates the consumers are continuing to prefer larger boats.

With the population growth and the "move to the city," over half the potential boat owners are living in multi-dwelling units. This life style makes it difficult to find a place for their car, much less a new boat and trailer.

Part of the immediate solution to our industry's problems is to attract better management to our existing small craft harbors and to encourage marina engineers to take an economic approach to the better utilization of space in our existing marinas. To take a quick look at marina design and the non-economics of our existing marinas, consider the following:

The average harbor with an all-slip moorage can berth only 15 to 20 boats per acre of water. This includes the main interior channel, fairways, and slip areas, but not the main entrance channel. Where bow and stern moorings are used in lieu of slips, this drops to approximately 10 boats per acre of water. For the normal distribution of boats, a minimum of three cars in the parking lot is required for every four boats in the water. Since about 90 cars can be parked per acre, that is roughly 1/6th of an acre of land for every acre of water and land utilization.

A recent study of municipal and private marinas indicates that the average slip is costing approximately $16,000. To arrive at this figure, the total cost of water acreage, bulk heads, gangways, headers, and slips, dock utilities, restrooms, area lighting, and parking lots were divided by the total number of boats in the mooring area. This would indicate that there are no economics in building marinas with slips under 30' in length. Now we should remember that slips over 30' account for only 20% of the total boats produced each year by the industry.

Now, how can we handle a large portion of the wet slip boats? Marina Associates' high speed, mast up, sailboat dry storage system can handle boats up to 30' in length and 10,000 pounds in weight and can dry storage up to 110 boats per acre of land, and a quarter acre of launching and retrieving slips. These same boats normally would require six acres of wet slips. Since approximately 55% of California marinas are occupied by sailboats in the 24' to 29' class, this would free up a considerable number of wet slips.

Now, for those trailerable boats up to 24' in length or the major portion of the industry's boats (that we all too soon won't be able to pull to the launch ramp) an average launching ramp or hoist will launch and retrieve about 50 trailered boats on a peak day and, because of staggered usage, car-trailer parking spaces will be required for only 80% of the peak traffic. Since about 30 car-trailer units can be parked in an acre of pull-through parking at 45 degrees, this works out to 1.33 acres of parking per ramp. The ramp road, wash down, and restrooms area will consume another 1/3 of an acre. This is another example of poor utilization of land and water in our over-crowded marinas.

Meeco Marinas high rise boat dry storage system can store, launch and retrieve 400 boats on 2-1/2 acres of land and 1/3 acre of water. These 2-1/2 acres of land also include all of the car parking required under a peak load use condition. To wet slip these same boats would require almost 20 acres of water.

For those of you not familiar with the term "high rise, dry storage," let me briefly describe the concept. It is a fully enclosed building with 1/3 of the structure over water. The reason for this is that our studies of wet and dry storage facilities over the last 14 years have proven that the average marina will never exceed a demand of over 1/3 of their boats out on any one day. This would include peak load days, like Memorial or Labor Day. The one-third over the water portion of the dry storage would house the high frequency users, the second third, medium frequency, and the last third of the building low frequency usage. The third over the water portion of the building has 32 holding slips for the boater to enter and leave his boat. It also acts as a holding area for the launch and retrieve flow during peak hours.

A building for 400 boats is approximately 90 feet wide at the base, 80 feet wide at the knee or top, 45 feet high, and 340 feet long. It can be operated with one operator during the week and an operator and dock boy on weekends. This is half the labor input for a facility of this size.

The building is designed to meet full hurricane wind loading, 100-inch snow loading, and full seismic 3 conditions. The building has been also designed to meet a minimum maintenance requirement for the first 20 years. This has been accomplished by coating the structure frame with a 20 mil. bitchamastic coating before the aluminum skin sheets are applied, going to aluminum racking with stainless steel fasteners and a Meeco floating docking system.

The crane system is designed also for a minimum 20-year life and can go through five motions at the same time. It can be traveling down the main runway, moving across the bridge, lowering turning up to 360 degrees, and positioning its forks all at the same time. This skill can be learned within a week by the average operator.

For lake conditions where land requirements are not available or where the normal pool is raised and lowered by downstream irrigation demands, we now have a 400 boat fully floating dry storage. Literature on this advanced dry storage system is available.

In 1962, the Outdoor Recreational Resources Review Commission did a study on our nation's shoreline suitable for recreational pursuits and found that less than four percent was accessible for public recreational use. Now some 17 years later it is estimated that less than half of this is now available for marina and recreational development, due to ecological and environmental pressures. This means we are now presented the challenge of doing something well in marina planning and management if we are to survive as a challenge to recreational dollars through the marina industry.

Our studies indicate a primary impediment to increased boating sales in most of the United States is the lack of sufficient acceptable storage facilities. The average owner uses his boat approximately 200 hours a year. The remaining 8,560 hours, or 98% of the time, the boat is in some type of dry or wet storage facility. We feel the answer to many of our industry's problems lies in the economics and space requirements of this storage.

In order to properly understand the complexities of our space requirements, consider these statistics:

1. The average adult, to stand comfortably, requires 5 square feet.

2. Packed in an elevator, he can manage on 2 square feet, but walking, he needs approximately 8 square feet.

3. His car, motionless, requires 200 square feet, and the average trailerable boat takes up an additional 200 square feet.

4. To wet slip the average boat requires approximately 1300 square feet, including dock water area and backing room. This is as much as the average dwelling unit in the United States.

5. Different systems of dry storage can reduce a boater's space requirement to 750 square feet.

Obviously, if everyone could dry store his own trailerable power or sailboat at his home, a portion of the problem would be solved. Unfortunately, our studies indicate a different situation.

A recent study of boat registrations and certain demographic trends in the United States was very enlightening. The prime market for boats can be easily categorized into (1) young pre-marrieds, (2) young marrieds, and (3) retirees. Not only are these the fastest growing segments of our population, but they have both the time and money for recreational products.

Our problem in reaching this huge potential market, however, is compounded by the fact that these groups show an increasing propensity for apartment and condo dwelling. The lack of storage facilities attendant to this mode of housing precludes storage at the residence. Studies by the state of California show that boats will not sell in a market where storage facilities are not convenient, economical and available. In the Los Angeles-Orange County area, for example, this factor limits the possibilities of boating for over 55% of the population.

Even the conventional home-owner is having increasing problems with storage space. In a rising number of communities, it is illegal to park boats in the front yard or driveway. In most cases, this simply means "no storage" because there is no way to reach the backyard with the trailer.

The sound economics of many marina operators to limit wet slips to boats over 25 feet and the idea of dry storing smaller boats has offered only interim relief to the congestion problem. The limited availability of waterfront land and attendant economics of trailer-storage precludesextensive use of single-level storage. The problem breaks down to one simple statement: To attract more people into marine recreation, we must provide more efficient boat handling and storage facilities for them.

Recently, to maintain California leadership in marina design and construction, the State Department of Boating and Waterways employed Williams-Kuebelbeck and Associates of Marina del Rey, California, to do a technical and economic evaluation of known dry storage systems for immediate use in California marinas. This study is one of the largest studies undertaken by a state governmental agency in attempting to better utilize their existing marinas.

Another recent significant study that addresses the subject of better marina design was done for the U.S. Army Corps of Engineers by James W. Dunham and Arnold A. Finn of the firm of Moffatt and Nichol in Long Beach, California. The title is "Small-Craft Harbors: Design, Construction, and Operation." It is well worth reading.

SEVENTEEN DESIGN CONSIDERATIONS

The following subject headings are the most common things not given proper consideration in designing efficient boat dry storage systems.

1. The Importance of Cube

In planning a boat dry storage rack layout, too often the designer overlooks the importance of the income potential of a cubic foot of space. In a well-laid-out rack system, a cubic foot of space, on the average, is worth $.046 per month, based on $2.50 a boat foot per month storage rate. A poor layout can reduce this to $.03 per cubic foot per month. A few examples of poor layout problems and how they affect cube are as follows:

a. Three 7'6" high rack openings (pigeon holes) will accept the average 22' long boat, producing a rental income of $55 per month per boat unit, or $165 a month for the three rack openings. If two 22' boats were stored requiring a rack opening of 11'3", the dry storage operator would be losing $55 of income per month. Therefore, if the marina operator chooses to store a 22' boat with a high keel to windshield dimension, he should be charging an additional $7.50 for each foot of boat height over 6'6".

b. By not specifying a full load side shifter on his forklift (a device that can move the boat right and left of the center line of the mast), it will cost him one foot additional within every rack unit, or a minimum loss of 10% of the total boats stored. In a 200 boat dry storage that would be approximately $12,000 a year.

c. By not having a fully adjustable load beam (the shelf beam the boat rests on), the dry storage operator cannot meet the constant changing boat size mix and will consequently lose a tremendous amount of cube income. In some dry storages, the fixed load beam is costing the operator up to 30% loss of additional income.

2. The Economics and Time Advantage of the Full Load Side Shifter

A full load side shifter is a device for moving the boat to the right and left of the center line of the forklift mast. This is not to be confused with a "fork positioner" which positions the forks in and out from center on the fork carriage. The full load side shifter actually moves the entire fork carriage and boat across the center line of the mast.

Therefore, if the operator comes into the rack opening several inches off center, he can center the boat with the side shifter rather than reposition the entire forklift. This unit can decrease his boat cycle time by as much as 25%, not to mention wear and tear on equipment and operator. This also means the dry storage operator can store 25% more boats per forklift unit.

The other major advantage is that the full load side shifter will allow the rack designer to reduce his rack load beam by 10% allowing more boats in a given area. With the high cost of waterfront land, this becomes economically important.

3. The Negative Lift Mast

In some areas of the country, tides play a major factor in the layout and selection of equipment for a forklift dry storage. If the dry storage operator or planner decides to use a negative lift mast, he should be aware how it will factor other elements of the total design, such as, bulkhead and bulkhead cap design, apron and floor loading, door height of building, last load beam height, height and pitch of roof in the building, location of area lights, and percentage of reduction of total load capacity of the forklift.

4. Supporting the Hull on the Rack Load Beam

Depending on tradition and where the dry storage is geographically in the country, there are two schools of thought on how to support the boat in the rack structure. The consensus of the manufacturers of boats is that if the boat is under 3,000 pounds it can be supported on bolsters (wood stringers). Boats over 3,000 pounds should be supported on swing chocks. The swing chocks should be adjustable both vertically from the load beam, as well as horizontally. Most manufacturers of deep "V" boats recommend supporting the entire boat on the keel. Therefore, the swing chock only stays the hull vertically. This means that the load beam must be able to support a concentrated point load without deflecting. Most rack manufacturing load beams are not figured for this type of load.

5. The Importance of the Bottom Load Beam in Racks

Some designers, to save money, will eliminate the bottom load beam in a boat dry storage rack layout. This not only seriously affects the overall structural value of the rack columns, but increases the cost due to the alternate type of boat support system. Since most good dry storage layouts have the main concrete floor area stopping at the face of the rack system with gravel under the racks, it is rather difficult to anchor the bottom boat support structure. The bottom boat is normally the hardest to get in, since the forklift mast is in its fully collapsed state, allowing the operator the least amount of vision. Therefore, it is easy to push the boat support system out of line.

6. Fork Positioners

Fork positioners are normally two hydraulic rams that position the forks on the fork carriage to the right and left of the center line of the mast. Some operators, to save money, will purchase manual fork positioners. The operator then has to climb down off the lift and physically move the forks, which due to their size and length can be very difficult. Therefore, the operator has a tendency to pick a boat with the forks in the wrong position which can damage hull supported equipment such as depth finders, as well as the hull itself.

In large dry storages (over 400 boats), numbers are used to locate and put away boats. Two sets of these numbers are found on the transom to indicate how to position the forks for the correct pick of the hull. This way the operator is also assured his forks are outboard of the rack load beam and chocking system.

7. Seismic and Wind Loading

Since geographically both earthquakes and hurricanes can play havoc with boat dry storages, it becomes a paramount consideration to check and make sure the rack and building manufacturers are aware of these requirements and that their equipment meets the design criteria. Very few manufacturers of racks can meet the requirements of full hurricane wind loadings or seismic 3.

8. Lighting

Most standard prefab buildings have fiberglass light panels located at mid points of the roof on a clear span structure. This is one of the most common mistakes in boat dry storage design, since it puts the light panels over the boats and not the main aisle where they are needed.

The electric light fixtures are sometimes hung too low and are easily struck by the forklift mast in its full up position. The forklift lights should be waterproof and be mounted on the side of the heel of the fork carriage with an efficient cord reel system. Normally they are on the truck where they do little good.

9. Storing Boat By Use

Most in and out boat dry storages never exceed a peak demand of over 33%. Therefore, to reduce the wear and tear on equipment and get the maximum efficiency out of the system, the boats should be stored by use factors, the high frequency boats closest to the launch and retrieve wells, the medium frequency in the second third of the building, and the low frequency (once a month) in the third of the building furthest from the launching wells.

In racking boats vertically, frequency should also be considered as far as cycle times per hour. Therefore, the second and third rack up should be for high frequency of use and the bottom rack and topmost rack for low frequency.

10. Holding Slips

One of the most common problems in dry storage design is insufficient holding slips. The rule of thumb here is that the holding slips should never be less than one-third of the peak load. Therefore, a 300 boat dry storage should have approximately 33 holding slips.

11. Concrete--Aprons and Main Aisle

A common observation in boat dry storage design is that the floor load in the building will be correct for the forklift, but the apron in the launch area will be wrong. This is common because the building engineer is not always responsible for the site work. Since boats are both drained and washed down on the launch apron, this area normally requires more attention to design than the building floor.

Common design errors are improper design of drainage systems, expansion joints, slab design, and improper compaction of subsoils. Consideration should be given to the concrete finish since too rough of a finish will wear out steer tires on the forklift at an alarming and costly rate.

12. Dollies or Fixed Stanchions For Wash and Hull Draining

In planning the operational aspects of a good dry boat storage system, too often the designer overlooks the importance of space on the launch apron. Again, the rule of thumb here is that if a 300 boat dry storage has 33 holding slips, it should have one-third or eleven dollies or fixed stanchions for wash-down and hull draining. Too often the boat wash-down is done on the forklift, thereby substantially reducing the return cycle time. In salt water operations, this is a poor practice since the operator is draining salt water out of the bilge onto the front end of the forklift and he is also washing the salt water off the boat and into the forklift.

13. Boat Transfer System

Boat transfer systems are used in tidal areas where the designer chooses not to use a negative lift on the forklift truck. The advantages are as follows:

a. The boat does not have to be backed into the pickup well. The transfer system can pick the boat up parallel to the bulkhead in either direction, thereby offering better entering and exiting from the mooring area.

b. With no negative lift mast on the forklift truck, the truck has more capacity and stability and is easier to service.

c. The cycle time is increased since the truck is not tied up launching and retrieving.

d. Wash-down can be done on the transfer unit.

e. Substantial hydraulic wear and tear is saved on the forklift since it does not retrieve. The retrieving cycle damages more hydraulic systems and engines since the operator has a tendency to accelerate the lift once the boat starts to lift from the water to compensate for the metrocentric characteristics of the hull.

14. Maximum Height of Top Load Beam

Most rack designers fail to realize the most economical height of the top load beam should not exceed 27'6". The reasons for this are as follows:

a. The four leading marina forklift manufacturers have a common forklift height of 30'--this is face of fork to floor. Since the forks are normally 8" in thickness and an operator needs retrieval room, 27'6" becomes a common top load beam dimension.

b. All forklifts have a three-point suspension system; if the mast preventers aren't properly set for the backward movement of the mast, the truck could become highly unstable.

c. Over thirty feet, the operator has a visual problem which requires a longer cycle time the higher he lifts the boat.

15. Boat Size Economics

One of the hardest problems to solve for the dry boat storage designer is boat size economics. The owner operator is normally a dealer with a couple of lines of boats. The top end of the line usually has a couple of boats with a beam over 8', length over 25', and a weight over 5,500 pounds. For the designer to consider these boats in his plan will drive the total cost of the facility up 25% for less than 5% of the boats. The reasons for this are as follows:

a. The lift truck will have to have a longer load center (over 8'), consequently a larger machine.

b. The building and operational apron floor loading will be higher, requiring a costlier slab.

c. The building main aisle will have to be wider so consequently the clear span building will have to be wider--dictating substantial more cost.

Since cube requirements of these larger hulls are substantial, it is often hard to justify additional monies per lin. foot. This non-economics for less than 5% of the boats can be the difference of a good return on investment versus a marginal one.

16. Fire Protection

In planning fire protection systems, the first thing that is brought up are the sprinkler systems. The results of many surveys by several of the major fire underwriter labs agree that attempting to sprinkle between the racks or above the racks would be of little value for two reasons: First, the rack load beams will always change in relation to the head location, due to the different size boats at different times. Second, the amount of water dumped into the boats would overstress and destroy the entire rack system and boats.

What is recommended by NFPA and the Underwriters Lab is as follows:

a. That approved 1-1/2 inch hose in 75 foot lengths will be provided and properly housed in hose houses equipped with play pipes, ordinary nozzles and fog nozzles, hydrant wrenches and spanners. These hose cabinet water feeds will be equipped with AFFF system foam 3% to 97%.

b. The building will be fully vented at the knee and ridge.

c. That the building have acceptable heat, smoke and central station signalling systems. These systems must have their own power back-up systems.

d. That the forklift be equipped with two 20 pound ABC dry chemical units.

e. That the building has fixed or portable ladders of sufficient length to reach every stored boat. These are located at quarter points in the building.

It should be noted that the building must be designed to store boats only and no repair servicing or fueling should be done in the structure.

17. Rack Rust

Even though major manufacturers of boat rack systems have attempted to protect the metal surfaces of their rack structures, through galvanizing and hard protective coatings, this has proven inadequate because of the following reasons:

First: Since forklift operators have both visual and control problems due to the type of equipment they are using, they have a tendency to scrape the top of the shelf beam with the bottom side of the forks, thereby exposing the steel and causing the resulting rust.

Second: Since the racks' bolster lumber supports or swing chocks are periodically being adjusted to accompany the constantly changing size mix of the boats, the shelf beams get nicked and scraped, and again the resulting rust.

All existing rack manufacturers have hollows or semi-hollows for their shelf beams and columns. It is sometimes difficult to develop adequate protective coatings on the inside of these structural elements. Unseen rust has caused structural failures in boat rack systems because of this problem.

CALIFORNIA MARINA DESIGN CONSIDERATIONS

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Since the late 1960's, public marinas in California have experienced a consistent trend toward the installation of concrete berthing systems. Many of these installations have served well and continue to satisfactorily function within the range of various uses and abuses at a given marina site. However, some of the installations have sustained damage and wear that goes beyond what could be considered "normal", and various problems have shown up regarding connections, hardware, design, etc.

As marina construction costs continue to rise, we must refine our efforts to obtain the best buy for our dollar. Therefore, in early 1978, the California Department of Boating and Waterways (Cal Boating) undertook a two-pronged effort to see if concrete berthing systems are really all that they are "cracked up to be". First, we hired a consultant to look at concrete systems from the standpoint of structural design and to recommend some minimum standards for future projects. The report on that work is finished and available through Cal Boating.* Secondly, we undertook several months of field work to look at existing concrete berthing systems to try to determine areas of weakness and/or strengths, and how we can improve upon past use of such systems. The fruit of that field work is what I have to share with you today.

Concrete floats are generally defined as lightweight concrete units cast monolithically around a core of polystyrene. The concrete is usually 100 to 110#/ft^3 and the foam core is 1 to 2#/ft^3. Various types of hardware are cast into the pontoons, and the systems are usually held together by pressure treated wood walers.

Concrete systems are damaged by various culprits, some of which are as follows:

1. Corrosion - sources are the environment via salt water, rain, heat, etc., and from birds. Results are seen in rusted bolts, connections, etc., and are particularly evident around pilings where gulls tend to roost. Cone shaped pile caps will eliminate most of the bird problems, and proper attention to hardware coatings and minimum sizes will combat rust problems.

2. Freezing - this is a very minimal problem along the California coast. However, spalling of the concrete deck has occurred where moisture froze repeatedly. Liquid waxes or other sealants will usually solve this problem in our relatively mild winter climate.

3. Wind Waves - probably one of the biggest sources of damage. Results in spalled concrete, sheared bolts, ripped out hardware, splintered walers, or all of the above. A good general rule of thumb seems to be that concrete will serve well in short period waves up to 12" with some damage expected if waves occasionally go up to 18". Extensive damage can be expected at 24" and above.

4. Surge - long period waves sometimes find their way through breakwaters and steadily work at connections, pile yokes and rollers, mooring cleats, and often hammer boats and floats against each other if boats are not tied up properly. The mass of the concrete pontoons work to the detriment of the system in heavy surge and the systems destroy themselves. Considerable damage was observed at some locations where surge ran 10" to 18" at periods of 1 to 5 minutes.

5. Boat Wakes - damage takes place in much the same way as with wind waves and can typically be found in berths adjacent to channels, fuel docks, etc. Enforcement of 5 mph speed laws will eliminate these problems.

6. Boat Operators - impact during docking operations is also a source of damage, particularly with larger fishing boats in commercial fishing harbors. Recreational boaters are typically more concerned about marring their hulls than are commercial fishermen. Damage includes broken or splintered walers, crushed pontoons, severed utilities, and broken hardware.

7. Poor Quality Control - this can be a huge problem, and one that may not show up until the system is in the water. I cannot over emphasize the importance of good, competent inspection during the casting of the pontoons. Possible problems include too little, or too much foam in the core (polystyrene), poor quality foam, poorly located foam, inadequate vibration of concrete, poor finish, etc. Carelessness in these areas can result in pontoons that are off balance, and have walls, bottoms and decks that are too thick or too thin. Concrete pontoons are relatively delicate, thin-wall structures that must be cast properly.

*For ordering information, see note at end of text.

8. Poor Field Installation - the best designed and quality cast system will not function properly if poor installation procedures are used. Broken corners, cracks, holes, etc., can result if pontoons are handled roughly, and stresses can be cranked into the system when tightening up connections. Whatever bolting up of walers and pontoons that takes place on shore should be left fairly loose so that the system can adjust when placed in the water. This will allow all pontoons to ride at proper height, and final tightening in the water helps allow a flat floating system with uniform freeboard. Also, under or over tightening of connections leads to obvious problems. Undertightening encourages the system to make "hinges" where none are desired, and overtightening leads to stripped threads, broken bolts, etc. Good, responsible installation crews are very important to successful concrete float systems.

As the result of the foregoing types of damage, we will now look at the various components of a typical system.

A. Knee Braces - these are busy places. They are locations for stress concentration inasmuch as this is where fingers are bolted onto walkways. They are also frequent locations for piles, storage boxes, utilities, and firehose cabinets. Typical construction consists of steel frames covered with plywood, steel, or concrete cover plates. We recommend that where piles are located at knee braces, cover plates not be used to transfer loads to or from the floats and piles. Rollers, wear strips, etc., should transfer loads directly from piles to the steel frames. To make the cover plates part of the structural system creates an impossible maintenance situation. Cover plates will not take the wear and tear required.

B. Pile Rollers - these are typically hard rubber rollers with a stainless steel axle, mounted on a galvanized steel frame. In surge areas, they do not work well against round piles, and particularly round concrete piles. The rubber wears thin in the middle of the roller and often wears it out prematurely. Rollers generally work well on square concrete piles, are quiet, and do not subject the pile to scraping and mechanical wear.

C. Pile Yokes - are typically fabricated of wood and/or steel. Steel yokes work well on wood piles, but in surge areas, piles were observed which had more than 50% of their cross-section worn away in the tidal zone. Steel yokes on steel piles work well, but some wear does occur, and they are noisy. A good arrangement is to use a steel frame and mount sacrificial wear strips of wood, rubber, etc., where they can be easily replaced. 4" x 4" oak was observed to work well for many years. In some cases, consideration should be given to attachment of wear strips to piles also.

Are rollers better than wear strips? It is hard to say from a general standpoint. Rollers are expensive, but work well in most situations, and they look clean and modern. Wear strips and simple U-shaped yokes are probably cheaper, may not look "up to date", but also work well. I have seen both types of installations wear out in a couple of months at specific sites and last for many years at other sites. It depends upon the specific site, and the relative stiffness of the float system and the type of piles used. Casual observation at a given site may indicate rollers or yokes are working poorly when in fact, all of the loads may be going into a handful of pile connections and subjecting them to unrealistic forces. The opposite can also be true. In a still basin, most any type of pile device will work well. We must be site specific in these types of details.

D. Storage Boxes - a favorite hangout for paint cans and utilities including water, electrical, and sometimes TV and telephone. Economy boxes are usually fiberglass, and the better boxes are made of high density cross-linked polyethylene at a cost of over $100 each. The big problem with storage boxes is that low profile boats (especially sail boats) often strike the back of the box when entering the berth, and impact forces are transmitted to the utility (water) lines. A common result is broken PVC water lines <u>below the deck</u>. Solution? Don't put utilities in the storage boxes. Place them in their own low profile cabinets. Your maintenance people will thank you for this.

E. Cleats - as the size of the berth goes up, the incidence of cleat damage increases. Many cases of both broken cleats and totally ripped-out cleats were observed. The basic problem seems to be inadequate bearing width on the bottom of the cleat where it bears on the wooden walers. A good permanent solution is to weld your steel cleats to a piece of 1/4" thick steel angle (3" x 6" works good) about a foot long. Bolt the angle down both vertically and horizontally through the walers and it will usually stay in place. This was observed to work well with commercial fishing boats in harbors periodically subjected to surge.

In Oregon, continuous 6" x 6" and 8" x 8" timbers are often installed along the main walkways in lieu of cleats, and are called "bull rails". They are set up on 3" blocks on 4' to 6' centers and bolted vertically through the walers with 5/8" bolts. Lines are tied to the bull rail and appear to work very well. Primary use is in commercial fishing harbors.

F. Utility Chases - locations of these chases are typically under the walers, through central chases and pull boxes cast into the pontoons, or in troughs cast into the decks of the pontoons. The troughs with simple covers offer immediate and easy access to at least 75% of the utility lines. However, they must be provided with drains and access ports where utilities can be teed off for lateral runs to service boxes, lights, etc. Water-hung utilities are simple and relatively inexpensive to install, but are subject to mechanical damage from boats (impact), and are frequently seen hanging in the water when the hanger straps break or rust out. Central chases and pull boxes in the interior of the floats are well protected, fairly cheap to install, but are difficult to repair because of limited access. Deck troughs are probably the best solution and are worth the extra cost.

G. Pontoon Connections - bolt up between wood walers and concrete pontoons is typically made by one of two basic methods; inserts or thru-bolts. Inserts are cast into the pontoons and are variously tied together with rods, rebar, or other anchoring hardware. Thru-rods are utilized by passing them through tubes in the pontoons formed by embedded conduits such as PVC. Without a doubt, thru-rod assemblies are superior to insert assemblies. Inserts can be stripped out and sometimes literally pulled out of the concrete. They are difficult to repair and you are stuck with whatever size insert/bolt size you install originally. Thru-rods, on the other hand, can be replaced when stripped or otherwise damaged, and larger rods can usually be used for replacement when necessary. Embedded conduits are typically 1" diameter. Thru-rod type floats utilizing both horizontal and vertical bolting arrangements are currently manufactured in California.

From a design standpoint, I have a suggested list of do's and don't.

(1) Do not place hose bibbs where they can drip on the pressure treated walers. Fresh water works down between the walers and between walers and pontoons, and deterioration takes place.

(2) Do not use steel hinges in conjunction with concrete pontoons. I have yet to see this done successfully. It allows too much movement and tears up the pontoons.

(3) If possible, avoid attaching fingers perpendicular to the last pair of fingerfloats at the end of a section of berths. This "fork" configuration is subject to stress concentrations, especially if the location is adjacent to main channels, fuel docks, or exposed to wind waves.

(4) Try to avoid discontinuities in walkway and fingerfloat alignment. For example, a 30° bend in a walkway is a likely trouble spot as are fingers that attach at 60°, etc. These spots experience a higher degree of sheared bolts, loosened connections, and general upkeep.

(5) Do not use steel members (usually angles of less than 1/4" thickness) for knee brace construction.

(6) Do not use bolts for connections of walers to pontoons of less than 5/8" diameter.

(7) Thicker walers are better than thinner walers from a wood quality standpoint. I consistently observed that 3X walers had less checks and structural deficiencies than did 2X walers.

(8) Do not use a steel trowel finish on the pontoons. They are dangerously slick when wet. A rough broom, wood float, or steel rod finish works well as do roughened patterns actually cast into the decks.

In summary, we can conclude that concrete is here to stay, but not without problems, and not all concrete systems are equal. They are expensive and will likely become more so. At $23 to $28 per square foot complete in the water, including utilities, strong incentive exists for competition from other types of systems utilizing wood, plastics, and metals. Hopefully this competition will be good not only for the marina industry in general, but will cause concrete berthing systems to become even better than they are now.

NOTE: The Engineering Study of Concrete Berthing Systems was done by Winzler & Kelly Engineers, 633 Third Street, Eureka, California 95501, and is available for $5 per copy. Write to:

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THE CORPS OF ENGINEERS PERMIT PROGRAM

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The U.S. Army Corps of Engineers is responsible for administering various Federal laws that regulate certain types of activities in specific waters of the United States and the oceans. The Corps' regulatory program is based primarily on Sections 9 and 10 of the River and Harbor Act of 1899; Section 404 of the Federal Water Pollution Control Act Amendments of 1972; and Section 103 of the Marine Protection, Research and Sanctuaries Act of 1972. I want to briefly discuss each of these and the mechanics of Corps permit processing.

The 1899 Act applies to "navigable waters of the United States," which are defined as tidal waters shoreward to MHW or MHHW (on the Pacific Coast) and waters which have had or are subject to interstate or foreign commerce. Section 9 covers the construction of dams, dikes, bridges and causeways. In 1966, however, bridges and causeways were transferred to the Department of Transportation. Section 10 covers dredging, filling and structures in navigable waterways.

Originally, the Corps administered the 1899 Act to protect the navigability of the waterways and permit applications were reviewed only for that purpose. In 1968, in response to a growing national concern for the protection of the environment, and in conformance with legislative acts and court decisions, the Corps revised its procedure to review applications for public interest factors in addition to the previous considerations of navigation only. Enactment of the National Environmental Policy Act of 1969 (NEPA) gave further support to this change in policy. The "public interest review" concept was challenged and upheld in court shortly thereafter.

The 1968 regulation was revised and updated in 1974 to include a number of developments which had occurred in the interim. Among these were Section 103 of the Marine Protection, Research and Sanctuaries Act (The Ocean Dumping Act), and the National Environmental Policy Act (NEPA) and Section 404 of the Federal Water Pollution Control Act (FWPCA). The Federal Water Pollution Control Act applies to what was defined as "waters of the United States," and regulates the deposit of dredged material or fill material in those waters. The Corps administratively determined that Section 404 of the FWPCA applied to the same waters as had historically been regulated as "navigable waters of the United States" under the 1899 Act.

In March 1975, this determination was challenged in court with the result that the Corps was required to expand its jurisdiction, under Section 404, to the headwaters of streams, defined as that point above which the average annual flow is less than 5 cubic feet per second. This required a further revision of the regulation which was published as an interim final regulation in July, 1975. After two years of experience with this regulation, the Corps revised it for brevity, clarity and organization and published it in the Federal Register in its final form on 19 July 1977.

A few days after enactment of the Federal Water Pollution Control Act Amendments, Congress passed the Marine Protection, Research and Sanctuaries Act of 1972. Section 103 of that Act is similar to Section 404 of the FWPCA in that it sets up a separate permit program to regulate activities which might affect ocean waters.

The Corps Districts are the action offices for receiving and processing applications, keeping records and performing enforcement functions. A small number of the most complex cases must be forwarded to higher authority (Division Engineer, Chief of Engineers or Secretary of the Army) for consideration. Regardless of the decision level required by any given permit application, the District Engineer remains the applicant's contact and actually takes the final action on the case.

The exact steps and the amount of work required to carry an application to its conclusion of issuance (or denial) varies widely depending upon the nature of the case; however, the steps generally required are:

A. An application - which consists of a form, a simple drawing describing the proposed activity, a location map; and other pertinent information.

B. A public notice - which is normally issued within 15 days of receipt of all of the items comprising the application.

C. A comment period which is normally 30 days, but the time may be altered in special cases.

D. And a decision/recommendation - at the close of the comment period the District Engineer assembles all the comments received and all available information concerning the proposed activity. Based on an evaluation of the factors shown, he makes a determination whether it is in the public interest

to issue or to deny the permit. If the final decision is within his authority, the permit is issued or denied at this point. If the case must be forwarded to higher authority, the case record, together with the District Engineer's recommendation, is referred to the Division Engineer for further action.

E. An EIS is required only in those cases in which the proposed activity is a "major Federal action significantly affecting the quality of the human environment," as defined in the National Environmental Policy Act. Many Corps permits are "major Federal actions," but may or may not qualify as "significantly affecting the human environment." This latter determination must be made by the District Engineer, based on the facts of the case. At any time during processing of the application, new facts may come to light which may affect his ultimate decision.

F. When there is an indication that a public hearing may yield substantive information about a proposed activity, particularly if an interested party has requested a hearing, the District Engineer conducts a public hearing. If the case requires an environmental impact statement, the hearing is held after the draft statement has been written. The hearing transcript becomes a part of the case record.

The District Engineer is responsible for enforcement of the regulation and laws relating to the permit program. When a violation is detected he issues a "cease and desist" order, conducts an investigation and a determination is made whether or not the violation should be referred to the U.S. Attorney for prosecution. In some cases it is possible and appropriate to work out a solution with the violator. If the case is referred, the U.S. Attorney may decline prosecution. In that event the District Engineer may accept an application "after the fact" for work which has been performed without a permit. All legal action must be completed (or declined) before he can accept such an application.

Violators may be subject to civil and/or criminal court action and penalties.

Now by way of making you instant permit experts, I would like to offer three hypothetical cases to illustrate the procedures followed by the Corps in processing applications;

1. Case I - Routine, non-controversial. This means that there is little or no substantive objection either from the public or from any level of government. It also has no appreciable negative public interest factors. It might be a private boat pier in an area where the shoreline rises abruptly from the water, and structures could be on piling with no dredging or fill required. This would make it purely a Section 10 action. If fill were required it would be a Section 10 and Section 404 action. The area, let's say, commonly has private waterfront piers with no public opposition.

Starting at the point at which the District Engineer has all the required information, including the application, location map and simple drawing, we can say he has "received" the application.

A preliminary environmental assessment will then be prepared to serve as a tool to aid in making a decision on whether an environmental impact statement will be required. In this example case we would expect the decision to be that a statement is not required. Where a statement is not required, the environmental assessment remains on file to document the action as required to comply with the National Environmental Policy Act. When used for this purpose, it is normally developed somewhat further than the preliminary environmental assessment.

A public notice describing the proposed work and soliciting comments will normally be issued within 15 days. The public notice will state the comment period, normally 30 days, at the end of which time the District Engineer will assemble and review the comments and all known facts of the case. He will then determine, based on the factors of public interest involved, whether or not the permit should be issued. In the example case, we would expect his determination to be for issuance and he would issue the permit.

2. Case II - This is also a routine case, but with either or both of two complications. One is that the state refuses to issue its state permit, or if it has no permit system the Governor indicates opposition to the activity. The other is that there are negative public interest factors which are determined to override the positive factors. Where the state (or Governor) is opposed to an activity the Corps will normally automatically deny the permit. A case in point where public interest factors are overriding might be where the applicant proposes to build a breakwater at his shoreline to prevent erosion to his property but the Corps, on investigation, finds that the proposed breakwater can be expected to cause erosion to a neighbor's property. We would expect denial of a permit for either of these reasons.

3. Case III - This case is illustrative of one of the relatively few cases which cannot be solved promptly. Assume the assessment indicates that an environmental impact statement is required and the comments and/or the District Engineer's knowledge of the situation indicates that a public hearing should be held. (Either or both of these may be required for a given case.) An environmental impact statement will be prepared, published in draft for 45 days comment period, have comments added, and be published in final form for comments for 30 days. The total time required for these steps normally ranges from a minimum of six months to one year, assuming no delays. The District Engineer will therefore commence EIS preparation as soon as possible, sometimes as early as the issuance of the public notice, so that it can proceed concurrently with processing of the application.

The public hearing also requires extra time since action on the impact statement is delayed between the draft, which should be available before the hearing, and the final, which may be affected to

some extent by information obtained at the hearing. Separately from the action on the impact statement, the assembly of comments and building of the case record has been proceeding. If, at the time of assembling the comments and other information about the proposed work, there are no outstanding unresolved objections from other Federal agencies and the case has not generated a high degree of controversy, the District Engineer may make the decision to issue or deny. If however, the case is very controversial and/or there are serious unresolved objections from another Federal agency, the District Engineer must write a report and send the case to higher authority for further action. This process can take a considerable amount of time.

There is another method of handling certain types of permit situations which we refer to as a general permit action. In the examples discussed so far each permit was issued to an applicant for one specific project at a specific location. Sometimes in a particular area certain types of work can be handled more expeditiously by first processing a permit for a certain well defined type of work such as a culvert, a small fill, or a private boat pier, and then when a person desires to perform work which meets the description and conditions specified in the permit he simply gets routine approval from the District Engineer. Usually the approval only requires a few days, since the permit process has previously been completed.

At first glance a general permit appears to be the great breakthrough in this time-consuming and sometimes frustrating business of processing permits. It does have potential and it is one of our top priority efforts throughout the Corps. But it does have limitations; it requires that the public and all the governmental agencies agree in advance that certain types of work will be acceptable anywhere in the defined area. This means great care must be used in describing the permissible limits of size, type, and location; all without knowing the actual site location in advance. The general permit is processed much like the ordinary one, except that it usually has no applicant and it necessitates making a decision based on a generic description of work to be performed anywhere in the area. It is therefore most applicable to routine, non-controversial types of work.

In the July 1977 regulation we introduced a third type of permit, called a "nationwide" permit. This allows certain routine, non-controversial types of work to be performed by anyone without first obtaining approval from the Corps at any level, so long as the work does in fact correspond to that described by the permit. The regulation itself, by specifying and describing these work items, serves as the permit. Work items thus covered are shown:

On 27 December 1977 the President signed the Clean Water Act of 1977. This is actually an amendment of the Federal Water Pollution Control Act Amendments of 1972 and introduces some new concepts into the Corps' regulatory functions. Two new provisions in the Act are most significant:

A. Most of the Corps expanded jurisdiction, resulting from the 1975 court decision, may now be transferred to the states. The Act provides that the Environmental Protection Agency will develop criteria which a state must meet in order to obtain transfer of the permit function to it. In states which do not elect to have the function transferred, the Corps will continue to administer the program.

B. The Act also declares that a Federal project, specifically authorized by the Congress, will not be subject to Corps permit action under Section 404, provided that an environmental impact statement which discusses the Section 404 (b) guidelines has been submitted to Congress prior to authorization or funding.

The Corps will revise its regulations governing permit programs in the near future to conform to the new legislation.

And now, let's recap a little. The three hypothetical cases I outlined would be typical of most of our work, and concerned with Section 10 and Section 404 permits. "Extra" procedures are required for many special situations. There are special procedures for the Ocean Dumping Act and the River and Harbor Act of 1902 (which relates to private improvement of waterways). The basic pattern is the same, however, as for our common Section 10 and 404 actions, and I would like to avoid cluttering up this discussion with these items.

The important concepts which I want to leave with you are: The 1899 Act with its navigable waters of the United States, the 1972 Act with its navigable waters, the public interest review, the National Environmental Policy Act of 1969 with its requirement for environmental impact statements and the principle steps in processing a permit. If I've made some sense out of these things for you, we have made good progress.

MAINTENANCE OF FEDERAL NAVIGATION PROJECTS WITHIN THE SAN FRANCISCO DISTRICT, CORPS OF ENGINEERS

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This morning I will present an overview of the Corps of Engineers maintenance responsibilities on navigation projects in the San Francisco District as well as a brief description of each of the projects.

First, before I delve into these projects, I would like to point out that the Corps constructs and maintains those navigation projects which Congress has authorized and funded. The congressional authorizations define the scope of the project, dimensions, and the degree of local cooperation required. We also accomplish work on military harbor projects when requested and funded by the defense agency involved.

The San Francisco District extends from the Oregon border, above Crescent City on the north to Cape San Martin in the south. Boundaries of the San Francisco District are defined by the Pacific Ocean, on the west, and the upper watershed limits of coastal streams to the north, east, and south.

Within the District boundaries, there are nineteen projects of which eight are adjacent to the coast and the remaining eleven fall within, or are contiguous to, San Francisco Bay, San Pablo Bay, and Suisun Bay. Seven of the projects are classified as deep draft projects, having authorized depths of 25 feet or deeper.

The Corps removes from 4,000,000 to 7,000,000 cubic yards of shoaling annually from the various navigation channels within the District. Repair of the breakwaters, associated with several of the projects, is done by contractor equipment. Dredging of the channels is accomplished either contractually or by Corps-owned seagoing hopper dredges.

Presently, there are three Corps-owned hopper dredges on the West Coast that divide their time between Seattle, Portland and San Francisco Districts. The Dredge Biddle which is the largest of the West Coast fleet has a hopper capacity of 3060 cubic yards. Second in size is the Dredge Harding which has a hopper capacity of 2682 cubic yards. The third and smallest is the Dredge Pacific which has a hopper capacity of 500 cubic yards.

The most northerly navigation improvement in the District is Crescent City Harbor, a shallow draft project, located near the California-Oregon State line. This project consists of an outer breakwater, an inner breakwater, a sandbarrier, an inner small boat basin and an outer basin. Commercial fishing vessels and petroleum barge movements constitute the major vessel activity of this harbor. Waterborne commerce reported in 1977 exceeded 288,000 tons of which 9,500 tons consisted of fish and the remaining traffic consisting of petroleum products delivered to the local distribution terminal. Maintenance of this project consists of occasional breakwater repairs and dredging of the harbor basins.

Approximately 60 nautical miles south of Crescent City is the deep draft project of Humboldt Harbor and Bay. This project consists of two breakwaters which extend approximately 4000 feet into the Pacific Ocean, a bar and entrance channel, and four interior channels within the north and south bays. Maintenance of the project entails the annual dredging of approximately 500,000 cubic yards of shoaling from the channels as well as occasional repairs to the breakwaters. Waterborne commerce reported in 1977 exceeded 1,640,000 tons which consisted primarily of pulp, chips, logs, various wood products, petroleum products and fish.

South from Humboldt Bay, near the town of Fort Bragg, is the shallow draft harbor of Noyo River. The project, inside of a cove, provides for two breakwaters and a river channel which terminates at the Harbor District mooring basin. Maintenance requirements vary with from 12,000 to 50,000 cubic yards of shoaling having to be removed annually. Jetty repairs have been minimal over the years. Waterborne commerce for 1977 was approximately 8,000 tons of fish unloaded over the docks. It is important to point out that Noyo River is the only improved harbor between Humboldt Bay and Bodega Bay and is an important haven and unloading point for the northward bound fishing fleet.

Bodega Bay which lies approximately 60 miles north of San Francisco is another shallow draft project which provides shelter and a discharge point to the northbound fishing fleet. Dockage is also provided for some recreational craft. The project provides for two breakwaters with an entrance and interior channel. Maintenance requirements have been minimal and infrequent at this location. Waterborne commerce reported in 1977 was approximately 2000 tons of fish. This harbor has the unique distinction of having an entrance in which vessel traffic enters from the east.

San Francisco Harbor is a deep draft project which provides for an entrance channel across a bar in the Pacific Ocean and further provides an approach channel to Islais Creek. The project involved the removal of numerous rocks in the bay in previous years. San Francisco Harbor project provides access to the Ports of Redwood City, Oakland, San Francisco, Richmond, Benicia, Stockton, and Sacramento. Average

annual maintenance dredging of the main ship channel (entrance channel) is 900,000 cubic yards of shoaling. Waterborne commerce through the entrance channel exceeded 56,000,000 tons in 1977. It should be noted that vessel drafts of 52 feet have been reported for this channel.

San Rafael Creek is a shallow draft project situated adjacent to the City of San Rafael in Marin County. There is no commercial traffic reported for this location; however, over 1000 recreational craft are reported to be berthed within the project area. The project consists of an entrance channel in San Francisco Bay and a creek channel which ends at Grand Avenue in San Rafael. Maintenance dredging requirements for San Rafael Creek are approximately 240,000 cubic yards of shoaling which are removed every four years.

Petaluma Creek, which lies in the northeasterly part of San Pablo Bay, is a shallow draft project providing an entrance channel in San Pablo Bay and a river channel which terminates in the town of Petaluma at the Washington Street Bridge. Approximately 25,000 tons of waterborne commerce were reported in 1977 for this location, and it consisted of shells and nonmetallic mineral products. Maintenance dredging requirements are approximately 270,000 cubic yards of shoaling to be removed from the river channel every four years and 400,000 cubic yards to be removed from the channel in San Pablo Bay every eight years. A number of recreational craft are berthed in the lower reach of the river channel.

Napa River is another shallow draft project which begins at the northerly end of Mare Island Strait and terminates at the Third Street Bridge in the City of Napa. Approximately 153,000 tons of waterborne commerce were reported in 1977 for Napa River which consisted of salt and fabricated steel products. Numerous recreational boats use this waterway also. Required maintenance dredging is approximately 700,000 cubic yards of shoaling every 12 years.

The San Pablo Bay and Mare Island Strait project is a deep draft project consisting of Pinole Shoal channel in San Pablo Bay extending from the vicinity of Pinole Point to the entrance of Carquinez Strait and a channel in Mare Island Strait running from Carquinez Strait northward to the Mare Island Causeway between Mare Island Naval Shipyard and the city of Vallejo. Pinole Shoal channel serves several large oil refineries as well as several upstream ports. Waterborne commerce reported in 1977 for the project was over 32,000,000 tons of various commodities. Maintenance dredging requirements for Pinole Shoal channel averages approximately 500,000 cubic yards of shoaling removed biannually and approximately 2,000,000 cubic yards of shoaling removed annually from Mare Island Strait.

Suisun Bay Channel, which lies in the southerly part of Suisun Bay, provides deep draft access through Suisun Bay from the city of Martinez to the city of Pittsburg and the ports of Stockton and Sacramento. Waterborne commerce reported in 1977 for the project was approximately 8,000,000 tons of various commodities. Maintenance dredging is required annually with approximately 180,000 cubic yards of shoaling removed.

Suisun channel is a shallow draft channel extending from the northwesterly part of Suisun Bay to Suisun City. Waterborne commerce is light with few vessel trips reported. Recreational craft berthed in the upper reach of the project are the main uses of the waterway. The channel runs through a large wetland area which presents a problem in future maintenance dredging and the associated disposal of shoal material. Past maintenance dredging has been small in quantity and infrequent.

Richmond Harbor is a deep draft project situated in San Francisco Bay and consists of a channel through Southampton Shoal to the outer harbor and an inner harbor channel extending through Santa Fe Channel. The Port of Richmond has been engaged in improving their dock facilities which is evident in the recent completion of a modern container handling facility. The port has recently applied for permits to construct a 500 boat marina within the inner harbor. Waterborne commerce reported for 1977 exceeded 23,800,000 tons. Predominant commodities reported were crude petroleum and petroleum products. Annual maintenance dredging requirements experienced are from 400,000 to 480,000 cubic yards of shoaling.

The deep draft project of Oakland Harbor consists of inner and outer harbors which serve dock facilities in Alameda and Oakland. Port of Oakland containership docks and handling facilities are responsible for an ever increasing commerce at this project with over 6,800,000 tons being reported in 1977. Oakland Army Base and Naval Supply Center, which serve the military's shipping requirements in the Pacific, are part of the outer harbor complex of docks. Numerous marinas line the inner harbor which provides bay access for large numbers of recreational craft. Maintenance dredging of Oakland Harbor is undertaken on an annual basis with approximately 500,000 cubic yards of bay mud having to be removed.

San Leandro Marina, located south of the Oakland Airport, is a shallow draft harbor serving recreational boating. The project provides for an entrance channel through the shallow flats of the bay and access channels at the marina. Maintenance dredging of the project is undertaken every four years, with approximately 115,000 cubic yards of shoaling requiring removal.

Redwood City Harbor, a deep draft project, lies approximately 20 nautical miles south of San Francisco. It provides a channel through San Bruno Shoal and an entrance and harbor channel at Redwood City. Waterborne commerce reported in 1977 totaled 410,000 tons. Maintenance dredging of the project is scheduled on a four year cycle for the removal of approximately 500,000 cubic yards of shoaling. Connecting with the deep water project is a shallow draft channel in Redwood Creek which provides access to deepwater for several marinas adjacent to the channel. Maintenance dredging required for this channel is minimal and infrequent.

The Half Moon Bay project located on the coast south of San Francisco at Princeton is a shallow draft project which provides for east and west breakwaters. This project provides protection to commercial fishing boats and recreational craft anchored within the harbor. Fish landings reported in 1977 totaled 566 tons. Maintenance of the breakwaters has been minimal to date.

Santa Cruz Harbor, located on the north shore of Monterey Bay, provides east and west breakwaters, an entrance channel from Monterey Bay, and a harbor channel with basin. The project protects over 360 small boats berthed in the harbor, most of which are recreational, from the heavy southerly winter seas. Annual maintenance dredging of the entrance channel averages approximately 90,000 cubic yards of sand which are pumped onto the beach east of the project.

Moss Landing Harbor, a shallow draft harbor located on the shore of Monterey Bay south of Watsonville, provides for two breakwaters, an entrance channel, and an inner harbor channel. The harbor provides protection for both commercial fishing vessels and recreational boats. Over 10,000 tons of fish were handled over the docks within the harbor in 1977. Maintenance dredging occurs every three years with approximately 60,000 cubic yards of shoaling being removed.

The Corps, in its maintenance of navigation projects within San Francisco Bay, operates four drift collection boats that collect floating debris from the bay. Collected debris is offloaded at our docks at Sausalito from where it is hauled to a land fill for disposal. Approximately 10,000 tons of debris are collected and disposed of annually.

Last but not least is the detached breakwater west of the entrance to Berkeley Marina. The breakwater was placed to protect the harbor and its entrance from the predominantly westerly chop and swell of San Francisco Bay. To date, no maintenance has been required for the breakwater.

In closing, it can be seen that the Corps has made a large commitment to navigation within the waterways under our jurisdiction and we pledge to continue this commitment in the future.

PERMITS, MARINAS, AND PUBLIC ACCESS

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INTRODUCTION

Thank you for having me here and welcome to the Bay Area. Since some of you are from the Bay Area, you have heard of the Bay Commission. Those of you that have not, would probably benefit from understanding its operation since in many ways the Bay Commission is the forerunner of other coastal agencies around the country.

Therefore, I want to provide you with some background on the Commission and to concentrate on public access, particularly as it relates to marinas. For your information, public access is a requirement of the BCDC permit process and, as you probably know, is becoming more and more a requirement of other states under the federal coastal zone management program.

AGENCY BACKGROUND

First, though, let's look at the background of our agency and of San Francisco Bay. In 1850, San Francisco Bay had nearly 500 square miles of open water. In 1963, the Corps of Engineers released a report portraying the potential of a bay being filled which left but a river down the middle. That report and ongoing filling activities prompted citizens, primarily here in Berkeley, to pressure their legislators to create the San Francisco Bay Conservation and Development Commission in 1965, as the state agency with planning and regulatory authority over the Bay. As the law was amended in 1969 after a rather bloody battle in Sacramento, BCDC was given permit authority over development activities within the entire Bay that is subject to tidal action, to a line just west of Pittsburg in the west Delta, including a 100-foot wide shoreline band. Our Commission of 27 members grants permits on the basis of the enabling law, the McAteer-Petris Act, and the findings and policies of the San Francisco Bay Plan, which covers a number of resources and uses of the Bay and shoreline including water-related industry, ports, salt ponds, dredging, marshes and mudflats, public access, and recreation--including marinas and commercial recreation, such as restaurants.

At this point, I would like to emphasize a few points about the operation and authority of BCDC. Keep in mind as a permit agency, we are reactive in nature and can affect uses and appearance of the Bay and shoreline only if development is proposed that requires a Bay Commission permit. A permit is required for any substantial change in use in the Bay, such as filling or dredging, or within 100 feet of the line of highest tidal action which is above the Mean Higher High Water line used by the Corps of Engineers. Through this permit process, we work with the applicant to see that public access and other features are provided as conditions of the permit.

Without getting into a lot of very specific requirements, I would just say that projects in the Bay are judged very severely as to the amount of fill that is proposed. Also, the uses that will be placed on that fill must be water-related before the Commission may consider them. While shoreline band projects are not judged as severely with regard to use, they can only be permitted if they provide maximum feasible public access to the Bay consistent with that project.

PUBLIC ACCESS

Once again I have mentioned public access. This is a good time for you to understand what we mean by public access. Our definition is from a finding in the newly revised Bay Plan Findings and Policies on Public Access: "public access required by the Commission usually consists of pedestrian access to and along the shoreline and beaches of San Francisco Bay. It may include certain improvements such as paving, landscaping, and street furniture; and it may allow for additional uses such as bicycling, fishing, picnicking, nature education, etc. Visual access to the Bay is a critical part of public access." The finding goes on to comment on the existence and need for the Commission's Design Review Board. As result of this requirement of the BCDC process, public access to the Bay has been provided in conjunction with such projects as restaurants, power plants, public streets, bridges, residential projects, ports, parks, and marinas.

Since we are a permitting agency, there are limitations in the permit process to obtaining good public access. Basically, we can only react and work with a permit application that is before us and as result the access usually stops at the property line at each end of the shoreline without making the appropriate connection to other public places or access ways in the area; that is, the access often lacks continuity.

PUBLIC ACCESS PLANNING

Largely as result of these limitations and the need to comprehensively study public access around the entire Bay shoreline, we were authorized by the Commission in 1977 to prepare a public access plan for the 900 plus mile shoreline of the Bay. Without boring you with the details of our planning process, I would just note that we looked at three resources basic to the Bay and public access, land use, natural resources and visual resources. Regarding existing and proposed land uses; first we inventoried and then analyzed them in relation to potential public access to and along the Bay shoreline. We then looked at natural factors; also doing an inventory, then analyzing them in relation to the potential for public access. And finally, and in some ways most importantly, we attempted to inventory and analyze the visual resources of the Bay shoreline: We found this latter factor was one of the more challenging aspects of the project because a visual analysis of this type resource had not been previously done or at least published. I would note that for most of these inventory steps, we utilized the color aerial photographs on file with the Army Corps of Engineers prepared by NASA.

The result of this process was a set of public access maps and a document known as the Public Access Supplement to the Bay Plan which was approved by the Commission on April 5, 1979. The Supplement is an advisory document to the Commission, the public and other interested parties with regard to issues of public access around the Bay. In addition to its advisory role, it amends the findings and policies of the Bay Plan relative to Public Access, and Appearance, Design, and Scenic Views.

DESIGN GUIDELINES FOR PUBLIC ACCESS

The final Supplement consists of three elements: The Bay Shoreline; Appearance and Design; and Implementation Elements. In my view, one of the important and most usable products of the public access planning project, is the "Public Access Design Guidelines," a part of the Appearance and Design Element. Copies of this photo-reduced document are here today for your taking. Since many of you will be getting more and more involved in the design and location of public access, I would like to spend just a few minutes concentrating on the fundamental principles of public access as we stated in our design guidelines booklet.

First, a basic premise: "Because of its importance in the Commission's consideration of shoreline band (and Bay fill) projects, the concept of public access should be integrated into the overall project design program at an early stage so as to be an essential part of the project and not appear as an afterthought."

Now, as to the design of public access. We found that all public access provided through our permit process should be planned, designed, executed, and maintained on the basis of following fundamental principles of public access:

1. Public Access should feel public;

2. Be usable;

3. Provide, maintain, and enhance visual access;

4. Enhance and maintain the visual quality of the shoreline;

5. Connect to other public access areas or public areas;

6. Take advantage of the Bay setting; and

7. Be compatible with the natural features of the shoreline, the project, and adjacent development.

It is important that public access be usable. It should take advantage of the intrinsic recreational capabilities, such as fishing. In addition, the facilities should provide basic public amenities such as benches, paths, trash containers, etc. Similarly obvious but often overlooked is the need for easy site maintenance which can be provided through durable materials, drought-resistant and saline tolerant plant materials, and other similar measures. Buildings should be designed and placed so as to provide for maximum sunlight and usable open space. While we normally frown on large parking lots immediately adjacent to the Bay, we do realize the need for public parking adjacent to Bay facilities particularly if those parking areas can be kept small, away from the Bay and adequately screened.

Under the general principle of providing, maintaining, and enhancing visual access, we believe it is critical that public access areas be designed so as to be visible from both public thoroughfares and the Bay. Buildings, structures, parking lots, and landscaping of new shoreline projects should not obstruct or detract from views of the Bay. As a landscape architect, I appreciate and enjoy healthy plant materials. However, overlandscaping that obstructs views of the Bay is not desirable. Therefore, control landscaping to preserve and dramatize Bay views is emphasized.

Maintain and enhance the visual quality of the Bay and shoreline. The Estuary Park area in Oakland is an example of how the shoreline has been utilized properly for Bay-related uses. The distribution facility and corporation yard is held well back from the shoreline while the park and public facilities are right on the Bay as they should be. Another way of maintaining and enhancing the visual quality is to use forms, materials, colors, and textures that are compatible with the Bay and adjacent development.

Connecting public access areas to other public access areas and public thoroughfares means just that. Take advantage of local park and open space systems, school and municipal buildings, and so forth as places for those connections.

Taking advantage of the Bay setting is perhaps one of the most difficult principles to convey to developers. Simply stated, all commercial facilities should relate to the Bay. They should take advantage of that setting by orienting to the views and providing physical and spatial connectors to the Bay at every opportunity. The Ancient Mariner Restaurant in Alameda depicts how the orientation can really provide an attractive setting with good Bay views. The developers have provided elevated places for viewing the Bay. The tower at the Seventh Street Terminal, Port View Park, is an outstanding example of a public access facility utilizing this concept. Enjoyable but safe views of the port operations are afforded from this tower.

Insure that the public access and development is compatible with the project, adjacent development, and the natural features of the shoreline. For example, the boardwalk at the Palo Alto Interpretative Center provides for observation and interpretation of wildlife without endangering either the habitat or the public.

PERMIT PROCESS

In the few remaining moments, I would like to talk just a little bit about the Bay Commission permit process. A point that cannot be emphasized enough is the need to come in early. Do not be afraid to contact the staff even if you have no concept as to the type of project you propose or even a precise location. By talking with us early, we can help put you on the right track before you have obtained your local approvals and started down the road to what could be a denial by our Commission. Some of you are aware that we cannot file a permit, that is officially begin to take action on it, until we have received local approvals. That is important, however, we are most happy to discuss preliminary plans at any time. Please call ahead, however, since our limited staff resources may mean that there will not always be an individual available if you just drop in.

You should know that our Commission was one of the first to have a statutory limitation on the processing time. In our case, a permit must be processed within 90 days of the filing date or it is granted by default.

As to your specific project, if you are proposing dredging, we need to know a number of things: how much you are proposing to dredge, what the long-term picture is in terms of future maintenance dredging, how often maintenance dredging will have to occur, the amounts, how it will be done, and in particular we need to know where the spoils will go both now and in the future. We have no problem with dredging per se, the problem is usually where the spoils from that operation are to be placed.

You may be proposing to place fill in the Bay. We always hope that no fill of any kind will be placed in the Bay. However, our policies do permit certain types of uses on fill, not the least of which is marinas. Regardless, any type of Bay fill whether it be floating fill, platforms on piles, centilever, or whatever, should be the minimum amount necessary and it should be for water-related purposes. In order to process your application, we will need to know the amount and type of fill, the uses of the fill, whether it would be seismic safe for public use, and other such details.

With regard to marina projects, we are particularly interested in the design and layout of the berthing, and provisions you would make for pump-out heads and holding tanks. As you know, there are increasing requirements for retaining all wastes from the Bay through the use of pump-out facilities.

And finally, regardless of the type of project you propose, we will want to know what you are proposing with regard to public access. It is not enough always just to have a public access walkway along the shoreline, but it should be designed to be attractive and usable for such activities as fishing, bicycling, picnicking, and other similar uses. We feel that a marina affords an outstanding opportunity to integrate public access into the marina functions.

VIRGINIA'S COASTAL MARINA INDUSTRY: A DESCRIPTIVE ANALYSIS

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During 1978, the Virginia Institute of Marine Science (VIMS) Sea Grant Marine Advisory Services program conducted a survey of commercial marinas in Virginia's coastal zone. Only commercial marinas with 10 or more slips for lease were included in the study. The purpose of the study was to describe basic characteristics of the industry and to provide industry and management agencies with an objective appraisal of the significance of this private sector, water-dependent access resource.

Surveyors gathered data by personally interviewing operators of 113 randomly selected marinas located between Virginia's fall line and the Chesapeake Bay/Atlantic Ocean. This random sample represents approximately two-thirds of the 180 commercial marinas existing in the state's coastal zone. The type of data collected included basic descriptive information on the nature of the businesses as well as expansion rates and problems, slip demand, boat use characteristics, employment and revenues generated.

During the 1977-78 boating seasons, the 180 marinas operating on Virginia's coastal shorelines provided storage capacity for over 13,700 boats (Table 1). This capacity consisted of just over 8,600 wet slips, approximately 2,200 of which were covered slips. The marinas collectively provided a dry land storage capacity for nearly 3,200 boats. Dry stack storage provided over 1,850 bays. Moorings accounted for only 62 boats but are beginning to slowly increase in number. Boat ramps were provided at 54% of the operations.

Table 1. Boat storage capacity of Virginia's coastal marinas during the 1977-78 boating seasons

Type of Storage		No. Boats
Wet Slips (total)		8,613
Open	6,431	
Covered	2,182	
Dry Land Storage		3,190
Dry Stack Storage (11 firms)		1,867
Moorings		62
TOTAL STORAGE CAPACITY		13,732

Many of the firms were family operated. The organizational structure was distributed as follows: corporations with less than ten stockholders - 49% of the firms; individual proprietorships - 39% of the firms; partnerships - 12% of the firms. Only 34% of the firms had paid managers with the majority run by owners/operators. The average age of the marinas was 23 years with age ranging from 3 to 110 years. Most firms had changed ownership at least once, as indicated by the average length of current ownership being 10 years.

In general, Virginia's marinas are open year round, however, 11% of the firms only operated half of the year while an additional 10% stayed open only three-quarters of the year. Virgina's over 139,000 registered boats are principally used from mid April to late October, a period of about six months.

The size spectrum of Virginia's marinas is much less than that on the West Coast. The land area of the marinas averaged 6.4 acres, ranging from 0.3 - 127 acres. Shoreline footage controlled by the operations averaged 828 feet (55 - 5,000 feet). The largest wet slip operation contained 300 slips with enough land area to house 85 boats on cradles or trailers. The largest stack storage firm, of which there are currently twelve, housed 450 boats up to 26 feet in length in a closed building.

As elsewhere around the country, expansion in the industry is slow. Only 38% of the firms expanded their facilities during the five year period from 1973-1978. Overall, marina operators felt that they needed a minimum of 6.1 acres of land area and nearly 800 feet of shoreline footage to operate a viable facility. These estimated minimum land requirements correlate well with the existing average marina dimensions mentioned previously. This indicates that the land area and shoreline footage of the existing operations have proven adequate, in the opinion of the owners. Adequate expansion room existed at 69% at the marinas.

Concerning future expansion planned for the five year period from 1978-1983, 49% of the operators indicated they would be expanding (Table 2). This expansion will consist of approximately 900 wet slips for boats up to 25' in length, 2,050 slips for boats 26' - 40' long and 750 slips for boats exceeding 40'. Dry land storage expansion will only account for approximately 300 boats, while dry stack storage will add 2,050 boats to the existing capacity. Only 30 additional moorings are planned. Total expansion will amount to an increase in boat handling capacity of about 6,100 vessels. This results in an average yearly expansion rate of 1,220 vessels. Major problems anticipated in future expansion projects are permits, financing, zoning land and waterfront footage, in that order.

Table 2. Marina capacity expansion anticipated by operators during the period 1978-1983

Wet Slips (total)		3,703
$\geq$ 25 foot boats	899	
26-40 foot boats	2,055	
$\leq$ 41 foot boats	749	
Dry Land Storage		295
Dry Stack Storage		2,055
Moorings		33
TOTAL CAPACITY EXPANSION		6,086

Unfortunately, the planned expansion efforts are not sufficient to meet even the past demand for berths. In 1976 commercial marinas turned away over 4,600 customers and in 1977 over 4,900 customers sought slips that were not available. Approximately 77% of all marinas had to turn away some potential customers in the two year period. Only 48% of the operations bothered with maintaining a waiting list during the 1977-78 boating season, since boat owners' loyalties to lists are frequently not strong. Collectively, the industry had over 1,400 persons on active waiting lists.

Virginia marinas primarily cater to recreational boats, but they also provide berths for two other important vessel owners, commercial fishermen and charter/head boat captains. Recreational boats occupied 94% of the slips and stack storage bays while 3% of the wet storage was utilized by commercial fishermen and 2% of the facilities by charter and head boats.

Overall, activity patterns of boat owners using Virginia marinas were dominated by fishing. Fishing accounted for 44% primary boat use with cruising/sailing accounting for 27% of the use, relaxing/socializing 21% and water-skiing 8%.

During 1977 employment supported by the services offered at Virginia's marinas totaled 882 full-time and part-time persons. Year round full-time employment accounted for 58% of the total employees, year round part-time employment for 6%, seasonal full-time for 22% and seasonal part-time employment for 13%. The primary position for which marinas encountered difficulties in locating and retaining quality people was that of mechanic. The 1977 service employee payroll was approximately $4 million.

Gross revenues of the marinas, when attributed to the types of vessels at facilities, exhibited a distribution pattern different from that of the vessels themselves (Table 3). Recreational boats represented 94% of the vessels berthed at marinas but only accounted for 82% of gross revenues. Commercial fishing vessels, 3% of the total vessels, brought in 12% of gross revenues. Charter and head boats, representing only 2% of the marina boat population, accounted for 5% of gross revenues with the remaining 1% of revenues coming from trade with government and other commercial vessels.

Table 3. Comparison between type of boat at marinas and sources of gross revenues for 1977-78 boating seasons

Boat Type	Proportion of Marina Capacity	Proportion of Contribution to Gross Revenues
Recreational	94%	82%
Commercial Fishing	3%	12%
Charter/Head Boat	2%	5%
Misc. (Gov't., etc.)	---	1%

In 1977, Virginia's 180 coastal marinas were responsible for gross revenues of approximately $32 million. The distribution of revenues differed between those firms selling boats and engines as compared to those

not involved in such trade (Table 4). Firms selling boats and engines derived 28% of their income from storage, 44% from sales and 27% from service work. Firms not selling boats and engines had their income distributed as follows: 58% from storage, 25% from sales and 18% from service. These differences indicate the significant impact that boat and engine sales have on the contribution of storage revenues to the marina operator. Only 13% of the marina operators surveyed derived their total income from the marina. Of those having other sources of income, 31% were retired from other occupations.

Table 4. Sources of 1977-78 revenues at marinas with and without boat and engine sales

	PROPORTION OF GROSS REVENUES	
Source of Revenues	Marina WITH Boat/Engine Sales	Marinas WITHOUT Boat/Engine Sales
Storage	28%	58%
Sales	44%	25%
Service Work	27%	18%

This overview of Virginia's coastal marina industry indicates that the industry is fragmented among many small firms, averaging only five employees per marina. The employment, payroll and revenues attributed to the somewhat amorphous assemblage of operations is not enormous. However, it is significant in that approximately 60% of the marinas are located in rural Virginia where there is little industry. In these settings, marinas not only serve as an important source of employment for skilled and semi-skilled workers, but also serve as a major mechanism for channeling tourist dollars into rural, waterfront communities.

ECONOMICS OF MARINE RECREATION IN WASHINGTON STATE

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INTRODUCTION

With funding from Washington Sea Grant, the Washington Public Ports Association, and the Northwest Marine Trade Association, the University of Washington has been conducting a series of studies on the recreational boating industry in Washington state. A technical advisory committee, the Smallcraft Harbors Research Advisory Group (SCHRAG) provides guidance in defining problems, reviews draft findings and assists in the transfer of pertinent information to users. Federal and state resource, planning, regulatory and environmental protection agencies, the marine industry and recreational boaters are represented through the SCHRAG membership.

Four closely related research projects have been addressed:

. Analysis of the economic impact of the marine recreation industry in Washington state

. An inventory of boat launch and moorage facilities in marine waters in Washington state

. An assessment of the present and future utilization of moorage and launching facilities by recreational boaters in Washington state

. An analysis of key industry problems

Several reports have been, or are being, written on our findings to date. This paper draws on one of them[1/] to discuss the economic magnitude and impact of the marine recreation industry in Washington state with particular attention to the moorage industry. A publication in progress[2/] and a completed inventory[3/] provide data for a discussion of the geographic distribution of moorage in 1966 and 1978.

ECONOMIC MAGNITUDE AND IMPACTS OF MARINE RECREATION IN WASHINGTON STATE, 1977

The marine recreation industry in Washington state is composed of five sectors:

. boat and trailer manufacturing

. other marine manufacturing

. marine transportation services (marina and moorage)

. marine trade

. miscellaneous marine services

Utilizing a business survey of representative firms in each sector and data from other sources, these five sectors were added to the 1972 Washington State Input/Output Table. Using dollar values deflated to 1972 levels, statewide impact of sales and purchases of the industry was estimated and the results inflated back to 1977 dollars. The direct output, income and employment statistics of each sector and the industry totals are represented in Table 1 below. Typical products and services of each sector and the markets they serve are included.

Respending of marine recreation industry revenues in Washington state produces further rounds of impacts, which, before they leak away through savings, out-of-state taxes, dividends and purchases of imported products swell statewide output to more than the original value of the direct sales. This multiplier effect is calculated for each of the five sectors and tabulated below in Table 2.

Even greater impacts are created when revenues from exports (out-of-state) sales induce new consumer expenditures by Washington households. These induced impacts are shown in Table 3 for sectors having significant export markets.

The whole industry is comparable in magnitude (sales) to two other important Washington industries: plywood manufacturing and canned food products.

Table 1. Washington State Marine Recreation - 1977.

SECTOR	REPRESENTATIVE PRODUCTS	PRIMARY MARKETS	DIRECT EMPLOYMENT	ANNUAL CONTRIBUTION TO WASHINGTON STATE'S ECONOMY: TOTAL SALES ($MILLION)	VALUE ADDED ($MILLION)	PAYROLL ($MILLION)
Boat and Trailer Manufacturing	Fiberglass Boats Boat Trailers Boat Repair	63% Out-of-State 31% Washington Consumers	4,390	207.9	101.3	52.2
Other Marine Manufacturing	Sailmaking Marine Publications Marine Sporting Goods Marine Electronics	31% Washington 20% Inter-Industry 17% Government 17% Investment 16% Out-of-State	790	32.9	19.6	8.3
Marinas and Moorage	Moorage Rentals[3] Boat Launches Boat Rentals Gas, Food & Beverages	98% Washington Consumers	430	14.1	10.8	4.7
Marine Trade	Marine Wholesale and Retail Sales	87% Washington Consumers	1,430	205.8	27.1	19.9
Miscellaneous Marine Services	Marine Insurance Marine Finance Charter Boats	98% Washington Consumers	1,300	45.7	26.1	7.6
TOTAL			8,340	506.4	184.9	92.7

Table 2. Direct and indirect multipliers.

	Boat and trailer mfg.	Other marine mfg.	Moorage/ marinas	Marine trade	Marine services
Total output (sales) per dollar of final demand	1.15	1.29	1.29	1.11	1.19
Direct and indirect income per $ final demand	.57	.77	.96	.93	.92
Direct and indirect employment per $million final demand	36.3	46.1	57.7	70.7	64.9

Table 3. Direct, indirect, and induced multipliers.

	Boat and Trailer manufacturing	Other marine mfg.	Marine trade
Total output (sales) per dollar of final demand	1.608	1.910	2.064
Direct and indirect income per $ final demand	.967	1.299	1.623
Direct and indirect employment per $million final demand	61.2	79.6	99.5

COUNTY LEVEL IMPACTS OF THE MARINE RECREATION INDUSTRY, 1977

Because counties have more open and simpler economies than the state as a whole, the direct and

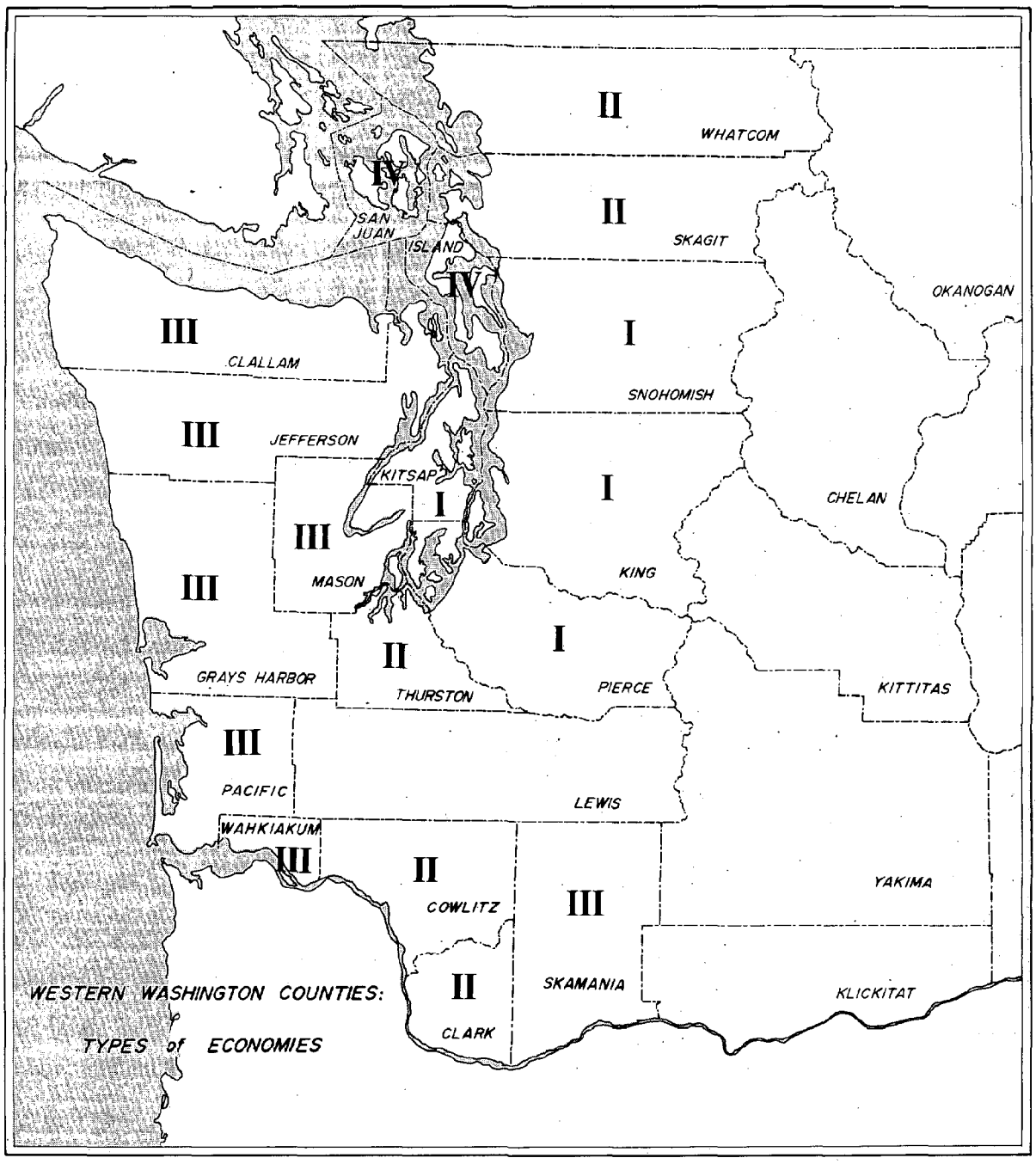

IV
II
WHATCOM
IV
II
SAN
JUAN
ISLAND
SKAGIT
IV
OKANOGAN
III
I
CLALLAM
SNOHOMISH
III
JEFFERSON
KITSAP
I
I
III
CHELAN
III
MASON
KING
I
II
GRAYS HARBOR
THURSTON
PIERCE
KITTITAS
III
PACIFIC
LEWIS
WAHKIAKUM
III
II
YAKIMA
COWLITZ
III
II
SKAMANIA
KLICKITAT
WESTERN WASHINGTON COUNTIES:
CLARK
TYPES of ECONOMIES
AI

Fig. 1

indirect impacts of marine recreation industries are smaller than the statewide impacts identified above. A greater range of goods and services must be imported into a county than into the state, thereby causing more leakage of respent industry revenue. But urban counties are more self-sufficient than rural counties since they have a wider range of goods and services produced locally. Rural counties vary in their economic structure too; some are dominated by natural resource oriented industry (forestry, wood products, agriculture); others have a strong recreation orientation.

Using standard techniques, Washington coastal counties were placed into one of four categories and the impacts of all five marine recreation industry sectors were estimated. Figure 1 maps counties by category and Table 4 tabulates for each sector the output (sales), income, and employment multipliers for each type of county.

Now, industries which, at the state level, have insignificant export markets, do export goods and services from a single county to the rest of the state. Therefore there are induced effects of respending export-generated household incomes within the county. These induced multipliers are tabulated in Table 5. again, for each of the five sectors and the four types of counties.

Table 4. Direct and indirect output, income and employment multipliers.

	State	Washington Counties Type I	Type II	Type III	Type IV
Output multiplier					
Boat/trailer mfg.	1.15	1.12	1.11	1.08	1.03
Other marine mfg.	1.29	1.26	1.20	1.18	1.08
Marinas/moorage	1.29	1.27	1.03	1.04	1.01
Marine trade	1.11	1.10	1.04	1.03	1.01
Services	1.19	1.18	1.12	1.15	1.11
Income multiplier					
Boat/trailer mfg.	.57	.56	.55	.54	.50
Other marine mfg.	.77	.75	.71	.71	.65
Marinas/moorage	.96	.95	.78	.80	.78
Marine trade	.93	.93	.89	.88	.87
Marine services	.92	.92	.87	.90	.87
Employment multiplier					
Boat/trailer mfg.	36.3	35.3	34.6	33.8	31.8
Other marine mfg.	46.1	45.2	42.3	42.6	38.2
Marinas/moorage	57.7	53.8	42.2	43.0	41.7
Marine trade	70.7	69.1	65.8	65.5	64.8
Marine services	64.9	67.3	63.1	65.3	63.4

Table 5. Direct, indirect plus induced income and employment multipliers.

	State	Washington Counties Type I	Type II	Type III	Type IV
Income					
Boat-trailer mfg.	1.17	1.15	1.13	1.11	1.03
Other marine mfg.	1.29	1.26	1.19	1.19	1.09
Marinas-moorage	1.25	1.23	1.01	1.04	1.01
Marine trade	1.08	1.08	1.04	1.02	1.01
Marine services	1.16	1.16	1.10	1.13	1.10
Employment					
Boat-trailer mfg.	1.72	1.67	1.64	1.60	1.51
Other marine mfg.	1.92	1.88	1.76	1.78	1.59
Marinas-moorage	1.90	1.77	1.39	1.41	1.37
Marine trade	1.56	1.53	1.46	1.45	1.43
Marine services	1.71	1.77	1.66	1.71	1.67

USE OF ECONOMIC IMPACT INFORMATION: A MARINA EXAMPLE

Suppose a marina is located in a type II county and has annual revenues of $150,000. Problem: Compute the statewide and county impacts of the marina.

A. Compute direct and indirect statewide impacts:

The output, income and employment multipliers statewide, for Marinas/Moorage are 1.29, .96 and 57.7 respectively.

$150,000 final demand x 1.29 = $193,500 statewide output (sales) of which...

$150,000 final demand x .96 = $144,000 statewide income
$150,000 final demand x $\frac{57.7}{1,000,000}$ = 8.66 jobs statewide

B. Compute direct and indirect county impacts:

The output, income and employment multipliers, for a Type II county are: 1.03, .78 and 42.2, respectively.

$150,000 x 1.03 = $154,400 county output

$150,000 x .78 = $117,000 county income
$\frac{\$150,000}{1,000,000}$ x 42.2 = 6.63 jobs in county

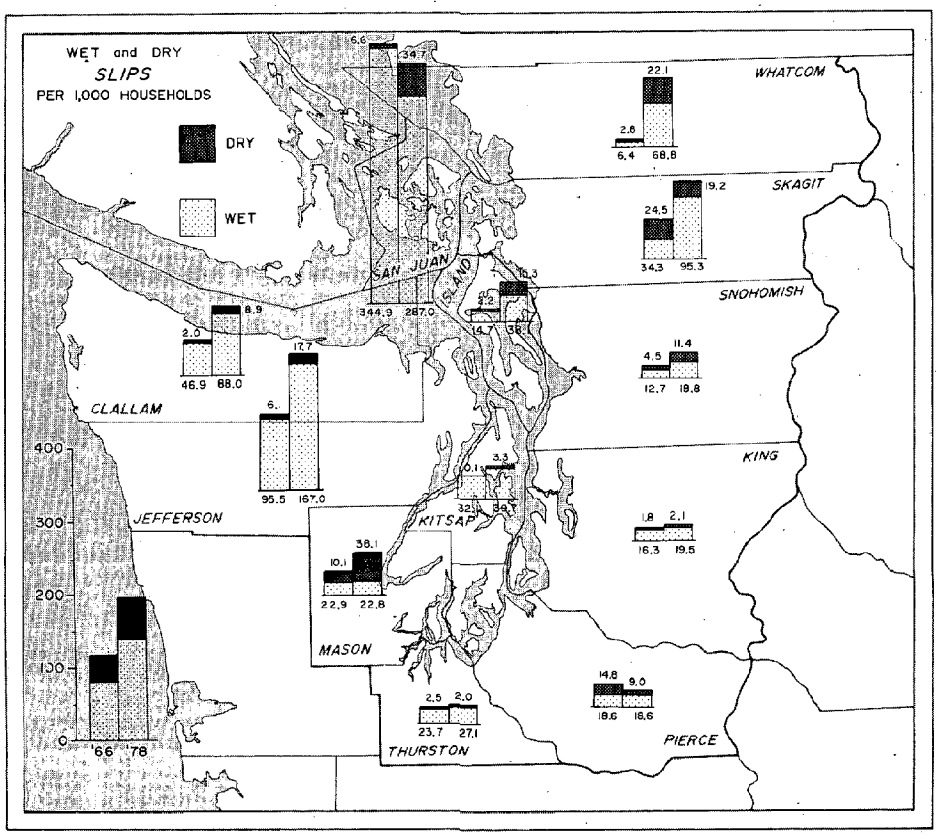


Fig. 2

GEOGRAPHIC DISTRIBUTION OF MOORAGE

Approximately 290 moorage facilities in Washington's coastal waters provided approximately 30,000 wet and dry moorage slips for commercial and recreational smallcraft in 1978. Of these moorages, 28,171 were on the shorelines of Puget Sound (including Lakes Washington and Union), the Strait of Juan de Fuca and the San Juan Islands (including Pt. Roberts). Twelve years earlier, in 1966, this region had 15,568 wet and dry slips. There are now 81% more slips than in 1966. Where are these slips? Where has the growth occurred? How are they distributed in relation to the boating population?

A. Distribution of moorage 1966-1978

Tables 6 and 7 and Figure 2 reveal the number of wet and dry rental moorage slips in each county available to boaters in 1966 and 1978. Counties are ranked for both years and the changes in rank noted in the tables. King and Pierce counties dominated the supply of moorage in both years, while Island, Mason, San Juan and Jefferson had the fewest slips. Only Whatcom county moved substantially in rank - up seven places.

Wet moorage. The region's number of wet slips increased 86% in twelve years with all counties gaining, but some more dramatically than others. Whatcom county increased almost tenfold, while King and Pierce increased 40% and 24% respectively. But the populous central Puget Sound counties had many more slips in the base year than did the rural counties and, therefore, while their percentage increase was smaller than the region's, they held their rank positions.

Snohomish, King and Pierce counties, the region's most metropolitanized, accounted for only 32% of the region's growth. Whatcom and Skagit counties had, combined, an almost equal share of 31% of the region's growth; and Pierce county's share (4%) was exceeded by all but three counties - San Juan, Island, and Mason. Each county's percentage change and its share of the region's growth in wet moorage are mapped in Figure 3 and tabulated in Table 6.

Dry moorage. Table 7 and Figure 4 repeat for dry moorage the analysis applied above to wet moorage. Again, Whatcom county's share (31%) of the regional growth is exceeded by only one county -- this time, Snohomish (35%), rather than King. Skagit and Pierce counties[4] show an absolute decline of dry moorage; Kitsap (7%), Island (8%), and Mason (13%) counties all show strong contributions to regional growth.

Tables 8 and 9 and Figure 5 document the number of wet and dry rental moorage slips/thousand households by county for 1966 and 1978.

Wet moorage. During the twelve year period, the regional average number of wet slips/thousand households increased 45% from 19.1 to 28.1, but vast disparities are evident within the region: San Juan County had twenty-one times more wet slips/thousand households than King county in 1966, and nearly fifteen times more in 1978. In 1966 the range was from 6.4 slips/thousand households (Whatcom) to 345 (San Juan); in 1978 the range was reduced only a little from 18.8 wet slips/thousand households (Snohomish) to 287 (San Juan).

B. Household's accessibility to moorage 1966-1978

A California study[5] of boating facilities and a theoretical analysis of participation in outdoor recreation both conclude that demand for recreational facilities is strongly influenced by the supply of those facilities, and further, that distance to those facilities from place of residence has a marked attenuating effect on the household's participation in boating activities. Symonds (1975) noted this distance effect particularly potent on participation in non-trailered boating.

An important consideration in assessing supply of moorage in Puget Sound and adjacent waters, then, is to measure households' accessibility to moorage. Counties were chosen as the geographic unit of inquiry, since the population of the region is confined by topographic features and historic development patterns to cities and towns close to saltwater. And, with the exception of north King and south Snohomish counties, those cities lie within one county. Furthermore, population census data and projections are readily available at the county level.

Table 6. Wet rental moorage in Puget Sound and adjacent waters, 1966-78.

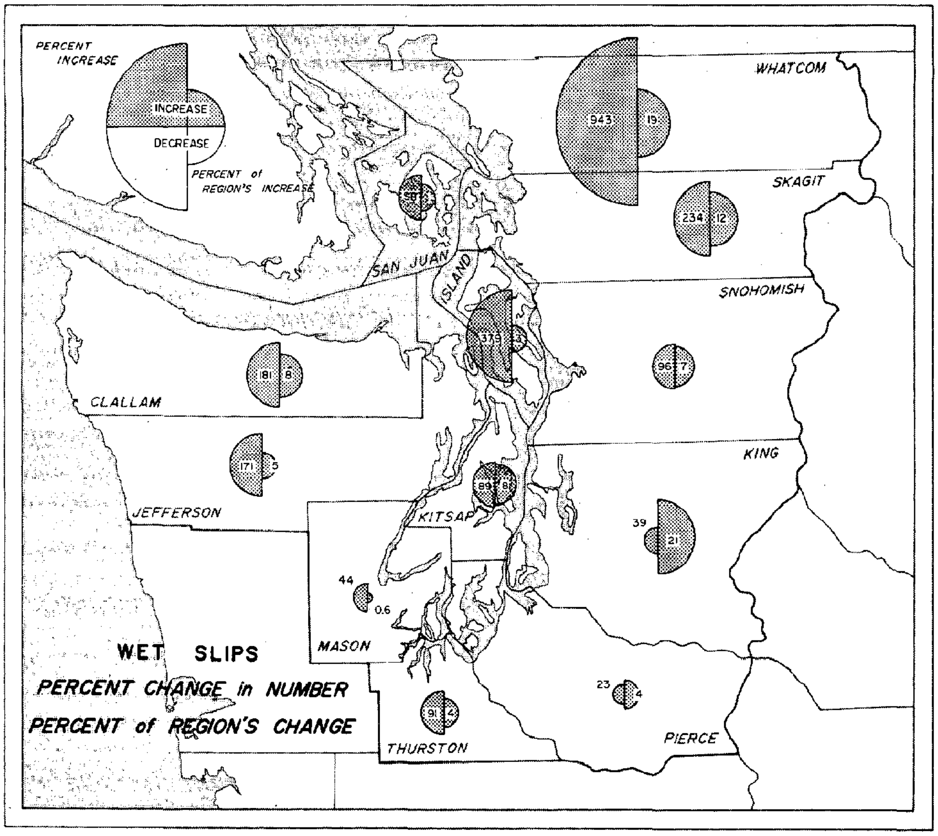
County	# wet slips 1966	Rank	# wet slips 1978	Rank	Change in # wet slips 1966-78	Change in rank	% change in # wet slips 1966-78	Rank	% Share of region's change in # wet slips 1966-78	Rank
Whatcom	214	10	2,233	3	+2,019	up 7	943.5	1	19.2	2
Skagit	561	5	1,879	4	+1,318	up 1	234.9	3	12.5	3
San Juan	416	8	827	10	+411	dn 2	98.8	6	3.9	10
Island	102	12	489	11	+387	up 1	379.4	2	3.7	11
Snohomish	864	4	1,701	6	+837	dn 2	96.9	7	7.9	6
King	5,756	1	8,033	1	+2,277	--	39.6	11	21.6	1
Pierce	2,049	2	2,533	2	+484	--	23.6	12	4.6	8
Thurston	511	6	978	8	+467	dn 2	91.4	8	4.4	9
Mason	137	11	198	12	+61	dn 1	44.5	10	0.6	12
Kitsap	943	3	1,787	5	+844	dn 2	89.5	9	8.0	5
Jefferson	313	9	851	9	+538	--	171.9	5	5.1	7
Clallam	494	7	1,392	7	+898	--	181.8	4	8.5	4
Puget Sound & adjacent waters region total	12,360		22,901		10,632		86.3		100+	

Source: Oceanographic Institute of Washington, Survey of Marine Boat Launching and Moorage Facilities in Washington, 1978.

Table 7. Dry rental moorage in Puget Sound and adjacent waters, 1966-78.

County	# dry slips 1966	Rank	# dry slips 1978	Rank	Change in # dry slips 1966-78	Change in rank	% change in # dry slips 1966-78	Rank	% Share of region's change in # dry slips 1966-78	Rank
Whatcom	70	8	718	4	+648	up 4	+925.7	4	31.4	2
Skagit	400	3	379	5	-21	dn 2	-5.3	11	-1.0	11
San Juan	8	11	100	10	+92	up 1	+1,150.0	3	4.5	8
Island	15	10	196	7	+181	up 3	+1,206.6	2	8.8	5
Snohomish	304	4	1,026	2	+722	up 2	+237.5	8	35.0	1
King	629	2	845	3	+216	dn 1	+34.3	9	10.5	4
Pierce	1,625	1	1,227	1	-398	--	-24.5	12	-19.3	12
Thurston	54	6	70	12	+16	dn 6	+29.6	10	0.8	10
Mason	60	5	330	6	+270	dn 1	+450.0	6	13.1	3
Kitsap	2	12	149	8	+147	up 4	+7,350.0	1	7.1	6
Jefferson	20	8	90	11	+70	dn 3	+350.0	7	3.4	9
Clallam	21	7	140	9	+119	dn 2	+566.6	5	5.8	7
Puget Sound & adjacent waters region total	3,208		5,270		+2,062		+64.3		100.1	

Source: Oceanographic Institute of Washington, Survey of Marine Boat Launching and Moorage Facilities in Washington, 1978.


PERCENT INCREASE
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WHATCOM
SKAGIT
SAN JUAN
ISLAND
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KING
JEFFERSON
KITSAP
MASON
THURSTON
PIERCE
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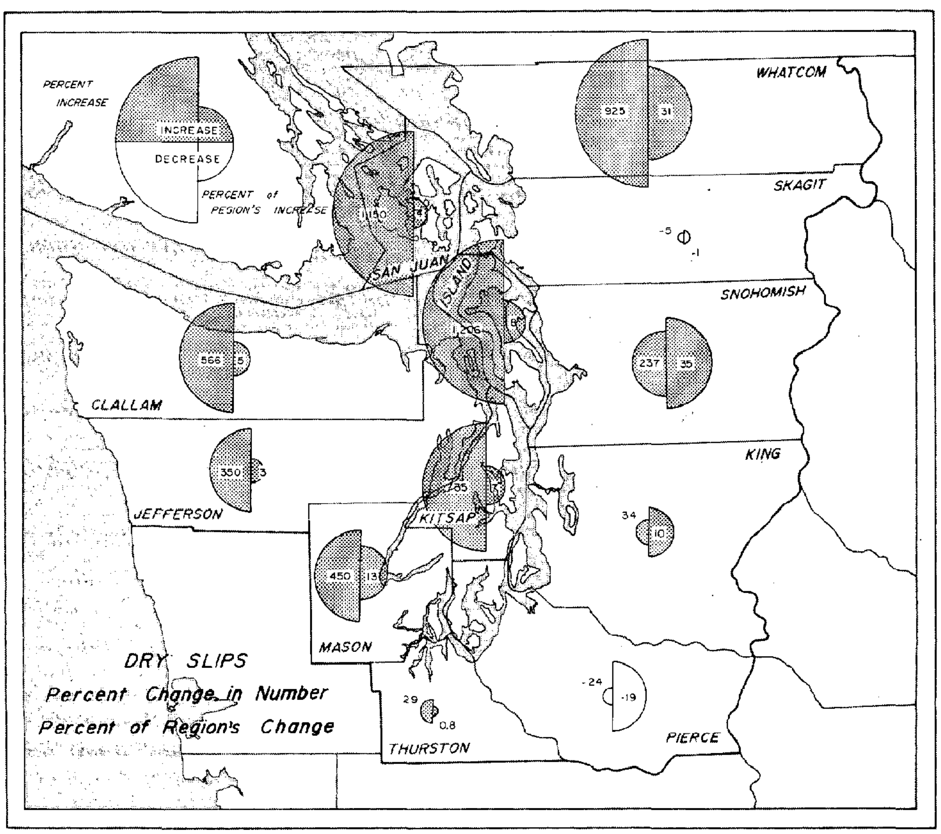
WET SLIPS
PERCENT CHANGE in NUMBER
PERCENT of REGION'S CHANGE

Fig. 3


PERCENT INCREASE
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WHATCOM
SKAGIT
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ISLAND
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JEFFERSON
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DRY SLIPS
Percent Change in Number
Percent of Region's Change

Fig. 4

Table 8. Wet rental moorage in Puget Sound and adjacent waters, 1966-78: # slips per 1000 households, expected # slips per 1000 households.

County	# wet slips 1966	[1] # house-holds 1966	# wet slips/ 1000 H's 1966	Rank	Expected # wet slips 1966	# wet slips above or below (-) expected # 1966	Rank	# wet slips 1978	[1] # house-holds 1978	# wet slips/ 1000 H's 1978	Rank	Change in rank 66-78	Expected # wet slips 1978	# wet slips above or below (-) expected # 1978	Rank	Change in rank 66-78
Whatcom	214	24,765	8.6	12	472	-258	10	2,233	32,446	68.8	5	up 7	912	1,321	2	up 8
Skagit	561	16,345	34.3	4	311	250	5	1,879	19,714	95.3	3	up 1	554	1,325	1	up 4
San Juan	416	1,206	344.9	1	23	393	1	827	2,881	287.0	1	-	81	746	4	dn 3
Island	102	6,893	14.8	10	131	-29	8	489	12,802	38.1	7	up 3	360	129	7	up 1
Snohomish	864	67,976	12.7	11	1,295	-431	11	1,701	90,357	18.8	11	-	2,539	-838	10	up 1
King	5,756	350,984	16.4	9	6,688	-932	12	8,033	410,089	19.5	10	dn 1	11,524	-3,491	12	--
Pierce	2,049	109,834	18.7	8	2,093	-44	9	2,533	136,156	18.6	12	dn 4	3,826	-1,293	11	dn 2
Thurston	511	21,511	23.8	6	410	101	6	978	35,971	27.1	8	dn 2	1,011	-33	8	dn 2
Mason	137	5,962	23.0	7	114	23	7	198	8,670	22.8	9	dn 2	244	-46	9	dn 2
Kitsap	943	29,346	32.1	5	559	384	2	1,787	44,964	39.7	6	dn 1	1,264	523	6	dn 4
Jefferson	313	3,275	95.6	2	62	251	4	851	5,094	167.1	2	--	143	708	5	dn 1
Clallam	494	10,530	46.9	3	201	293	3	1,392	15,809	88.0	4	dn 1	444	948	3	--
Puget Sound and adjacent waters region total	12,360	648,627	19.1	--	12,360	--	--	22,901	814,953	28.1	--	--	22,901	--	--	--

[1] Numbers of households in 1966 and 1978 were estimated by linear trend extrapolation of U.S. Census of Population, 1960, 1970, county population and household size statistics.

Table 9. Dry rental moorage in Puget Sound and adjacent waters, 1966-78: # slips per 1000 households, expected # slips per 1000 households.

County	# dry slips 1966	[1] # house-holds 1966	# dry slips/ 1000 H's 1966	Rank	Expected # dry slips 1966	# dry slips above or below (-) expected # 1966	Rank	# dry slips 1978	[1] # house-holds 1978	# dry slips/ 1000 H's 1978	Rank	Change in rank 66-78	Expected # dry slips 1978	# dry slips above or below (-) expected # 1978	Rank	Change in rank 66-78
Whatcom	70	24,765	2.8	7	122	-52	9	718	32,446	22.1	3	up 4	210	508	1	up 8
Skagit	400	16,345	24.5	1	81	319	2	379	19,714	19.2	4	dn 3	127	252	5	dn 3
San Juan	8	1,206	6.6	4	6	2	5	100	2,881	34.7	2	up 2	19	81	7	dn 2
Island	15	6,893	2.2	9	34	-19	6	196	12,802	15.3	6	up 3	83	113	6	--
Snohomish	304	67,976	4.5	6	336	-32	8	1,026	90,357	11.4	7	dn 1	584	442	2	up 6
King	629	350,984	1.8	11	1,736	-1,107	12	845	410,089	2.1	11	--	2,652	-1,807	12	--
Pierce	1,625	109,834	14.8	2	543	1,082	1	1,227	136,156	9.0	8	dn 6	880	347	3	dn 2
Thurston	54	21,511	2.5	8	106	-52	9	70	35,971	2.0	12	dn 4	233	-163	11	dn 2
Mason	60	5,962	10.1	3	29	31	3	330	8,670	38.1	1	up 2	56	274	4	dn 1
Kitsap	2	29,346	0.1	12	145	-143	11	149	44,964	3.3	10	up 2	291	-142	10	up 1
Jefferson	20	3,275	6.1	5	16	4	4	90	5,094	17.7	5	--	33	57	8	dn 4
Clallam	21	10,530	2.0	10	52	-31	7	140	15,809	8.9	9	up 1	102	38	9	dn 2
Puget Sound and adjacent waters region total	3,208	648,627	5.0	--	3,208	--	--	5,270	814,953	6.5	--	--	5,270	--	--	--

[1] Numbers of households in 1966 and 1978 were estimated by linear trend extrapolation of U.S. Census of Population, 1960, 1970, county population and household size statistics.

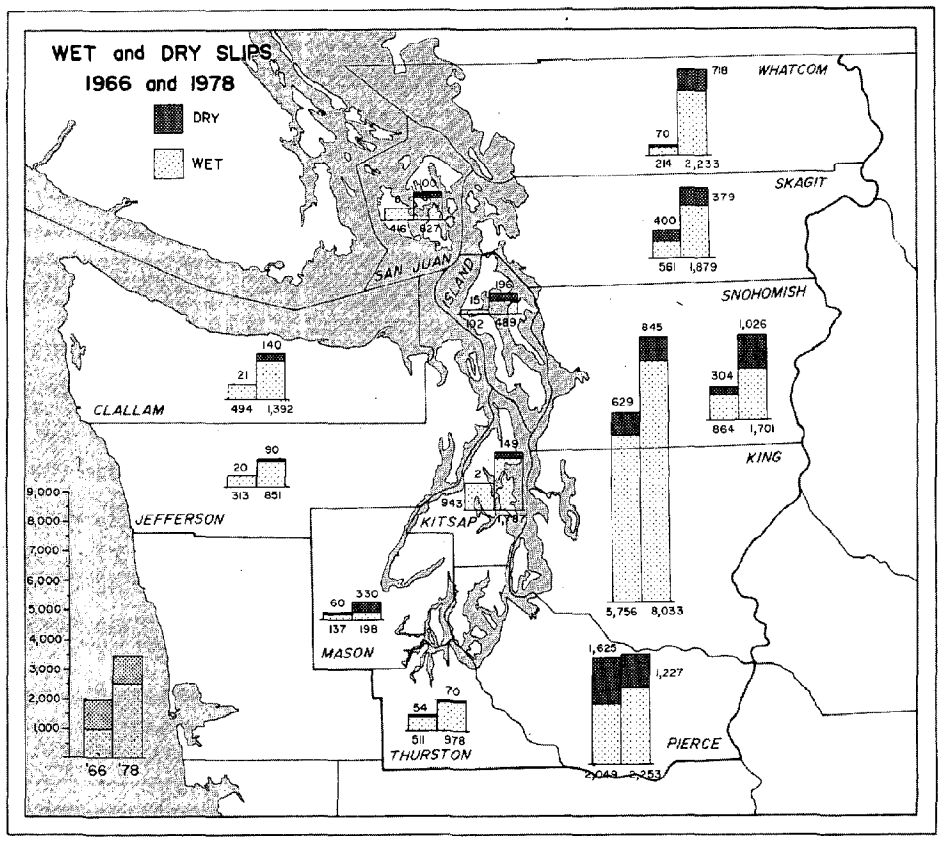


Fig. 5

A clear pattern of distribution is evident: the most populous urbanized counties have the fewest number of wet slips/thousand households, while the rural counties, led by San Juan and Jefferson, have the most. Further, the gap has widened during the twelve year period. The five counties with the greatest increase in slips/thousand household are all rural (Whatcom, Skagit, Island, Clallam and Jefferson). Another way to understand these regional disparities is to calculate how many slips each county would have if it conformed to the regional average number of slips/thousand households; then, compare this "expected" number with the actual number of slips. Figure 6 displays the results of this calculation performed in Table 8. King, Pierce, and Snohomish counties have high "deficits" of wet slips and, in each case, the "deficit" has grown since 1966. Clallam, Jefferson, San Juan, Whatcom and Skagit all have high "surpluses" of wet slips, and these, too, have increased since 1966. Thurston, Island, and Mason counties are close to the "expected" number and have changed little during the twelve year period. Kitsap is the only central Puget Sound county to have had a significant and increasing "surplus" of wet slips.

Dry moorage. The corresponding increase in accessibility to dry slips was 30.7%, from 4.95 to 6.47/thousand households. The range for dry slips was from 0.1 to 24.5/thousand households in 1966 and from 2.0 to 38.1 in 1978. The meaning of the data presented in Table 9 and Figure 7 is less clear than is the case for wet moorage. The reasons are several: first, dry moorage may be satisfying a different kind of market than wet; that is, dry moorage, particularly stacked, dry moorage adjacent to water is largely an alternative to trailered boating. A visual assessment of facilities on Lake Union supports this contention. Secondly, it is a rather recent phenomenon responding to the difficulties encountered in construction of new or expansion of wet facilities, congestion at boat launch ramps, and the cost and inconvenience of transporting boats on trailers. Dry, open storage yards are used for maintenance and repair of boats normally moored in water, or for off-season vessel lay-up. Facilities designed as real alternatives to wet moorage for non-trailerable boats are recent and rare. Their economic success is as yet unproven and their numerical significance low.

The only significant observations to be made on the data presented are that King County, with 18% of slips less than expected, is the most poorly served by dry moorage facilities and that the variation among other counties is much lower than for wet moorage.

ONGOING RESEARCH

Recreational boaters' demand for moorage and launch facilities in Washington state. The most frequently asked question concerning recreational boating is: How many boats are there in Washington state? or Puget Sound? The need behind that question usually relates to moorage. Typically, a marina consultant

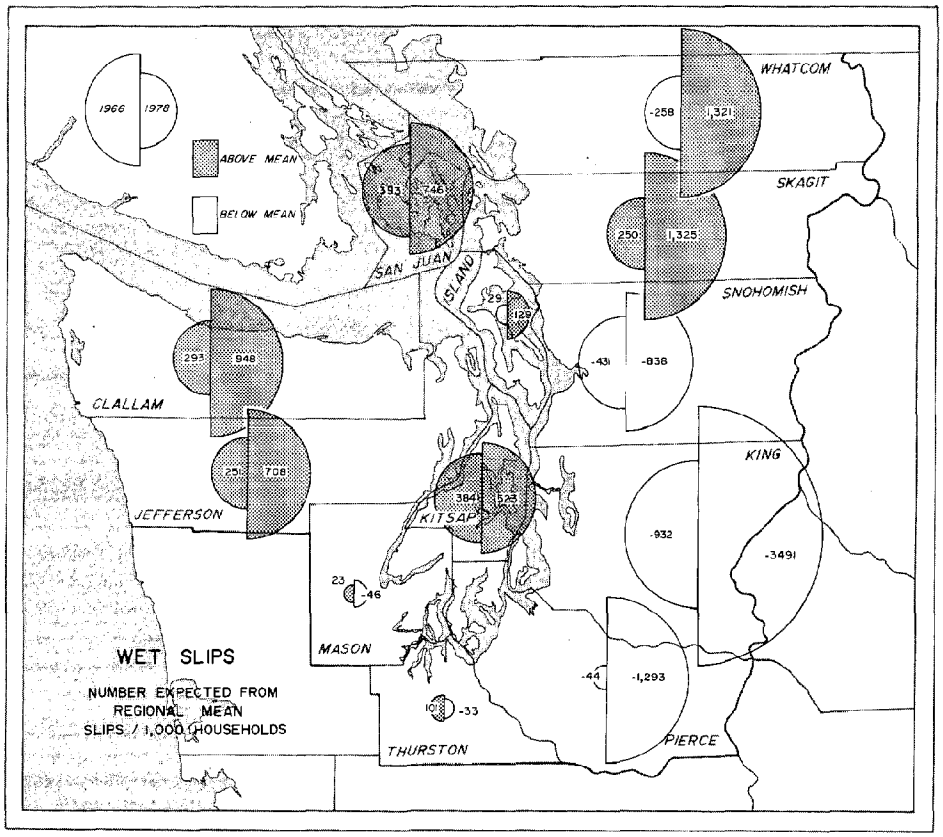
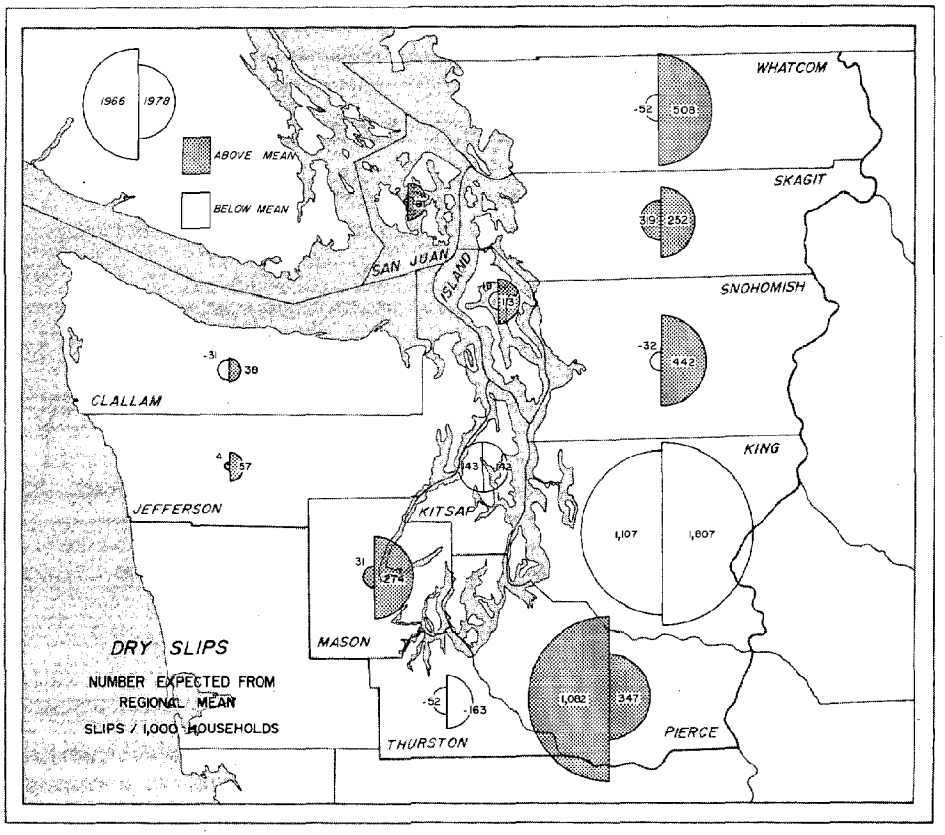

1966
1978
ABOVE MEAN
BELOW MEAN
WHATCOM
SKAGIT
SNOHOMISH
SAN JUAN
ISLAND
CLALLAM
JEFFERSON
KITSAP
KING
MASON
PIERCE
THURSTON
WET SLIPS
NUMBER EXPECTED FROM
REGIONAL MEAN
SLIPS / 1,000 HOUSEHOLDS

Fig. 6


1966
1978
ABOVE MEAN
BELOW MEAN
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SKAGIT
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SAN JUAN
ISLAND
CLALLAM
JEFFERSON
KITSAP
KING
MASON
PIERCE
THURSTON
DRY SLIPS
NUMBER EXPECTED FROM
REGIONAL MEAN
SLIPS / 1,000 HOUSEHOLDS

Fig. 7

under contract to a public port authority or a private marina developer is attempting to estimate demand for a proposed facility somewhere in coastal Washington.

Because Washington is one of only two states[7] without a state boating safety or registration statute, registering smallcraft becomes a federal responsibility under the federal Boating Safety Act of 1971.[8] The agency responsible for maintaining data on vessel ownership in Washington state is the U.S. Coast Guard. A computer analysis of the U.S. Coast Guard registration files revealed that, in spring 1979, 65% of the vessels on file had expired registrations. Most observers conclude that this statistic reflects data management problems rather than a failure to register recreational smallcraft.

Thus, the most commonly asked question: How many boats are there in Washington state? cannot be answered with great reliability.[9] The Coast Guard has 134,354 undocumented pleasure smallcraft on file. The author believes this number is seriously underestimated and that it should be approximately 197,000.

In separate bills before committees in both the House and Senate the legislature is beginning to address the need for boat registration in Washington state. At time of writing neither Bill is expected to come to the floor for a vote during the first 60 day regular annual session of Washington State Legislature. Until such time that either the State enacts a boat registration Bill or the U.S. Coast Guard upgrades its data management system, any estimate of the magnitude of the recreational smallcraft fleet in Washington state will be conjectural.

During June, 1979, the Washington Sea Grant (WSG) Program, with the assistance of the Northwest Marine Trade Association (NMTA) conducted a survey of 3,500 boating households in Washington and northern Oregon Columbia River counties. The purpose of the survey was, first, to measure the characteristics of the recreational smallcraft fleet; propulsion, size, construction, age, value, etc.; second, to gauge the patterns of utilization of the fleet: number of days used, time of year used, boating area used, size of boating party, etc.; third, to assess the demand made by the fleet on moorage, storage and launch facilities: permanent, seasonal, temporary and transient use of marinas and dry storage, and frequency of launch ramp use; fourth, to estimate the economic impact of recreational boating expenditures on the state's economy; fifth, to identify the factors responsible for vessel damage; and, finally, to poll boaters' attitudes toward key issues in boating: boating safety, product quality, quality of facilities, minimum requirements for operating a boat, etc.

To ensure its application to planning activities, the information will have a geographical perspective: that is, regional characteristics and trends in recreational boating and utilization of boating facilities will be broken down by county to indicate subregional variations, using the tools of the geographer - maps and spatial analysis of data.

The study area for destination boating needs and activities includes all Washington coastal counties and the counties bordering the Washington bank of the Columbia River upstream to the Bonneville Dam.

The U.S. Army Corps of Engineers analyzed the returned questionnaires and compiled some of the tabulations contained in the body of this report. These data will be used in their 1980 Boating Facilities Study for Puget Sound and Adjacent Waters. The Corps' study is designed to pre-designate sites for smallcraft harbor development, and perform an environmental assessment on each site, during which the views of state and federal permit-reviewing agencies will be sought. The Corps feels that pre-designation of suitable sites will remove much of the uncertainty confronting public smallcraft construction projects.

Because the Corps issues two critical permits for construction in navigable waters and wetlands (§10 Rivers and Harbors Act 1899; §404 Clean Water Act, 1972 as amended) and is responsible for coordinating the comments of other federal and state reviewing agencies, it is in an unique position to initiate advanced, long-range planning for development.

Because of the number of responses to the survey are small when disaggregated to the county level, other sources of data will be used to supplement those from the Boating Household Survey. These include tenant-origin studies of selected public and private smallcraft facilities and the results of a survey to be conducted at the January, 1980, Seattle Boat Show, sponsored by the NMTA.

CONCLUSIONS

We have completed the first, comprehensive analysis of the moorage industry in Washington state. The location, size, character and spatial distribution of moorage facilities in Washington's coastal counties have been documented. Estimates of the economic magnitude and impacts of the marine recreation industry have been developed at Statewide and county levels.

Work underway will provide similar information about the character, size and spatial distribution of present and project demand for these facilities. A refined estimate of the impact of boaters personal consumption expenditure on the state's economy is also in progress and will add new knowledge about the importance of boating to Washington's economic well-being.

We hope that the results of our studies will assist planners, regulatory agencies, the legislature and the industry to respond more effectively to the demands recreational boating places on our coastal resources, while maintaining the aesthetic quality of our marine and coastal environments. It is this quality, after all, that boaters in Washington state's marine waters seek out for their recreational boating pleasure.

ENDNOTES

1. Ellis, Roy C. et al., Economics of Marine Recreation in Washington State - 1977, U.W., 1979.

2. Goodwin, Robert F. and Robert Stokes, The Marina Industry in Washington's Coastal Zone, Washington Sea Grant, (forthcoming).

3. Oceanographic Institute of Washington, Survey of Marine Boat Industry and Moorage Facilities in Washington, 1978.

4. Missing yacht club data in Pierce county accounts for part of this "lost" dry moorage.

5. Symonds, Philip John, Equity and Efficiency in State Coastal Resource Management: An Application to Urban Recreational Boating Policy, Center for Public Affairs, Univ. of So. California, 1975.

6. Cicchetti, Charles J., The Demand and Supply of Outdoor Recreation, U.S. Bureau of Outdoor Recreation, Contract #7-07-04, June, 1969.

7. New Hampshire and American Samoa have no state boating registration.

8. 46USC 1451-89

9. The U.S. Coast Guard registers all smallcraft with motors in WA state.

10. These tabulations are presented in Appendix A.

APPENDIX A

SELECTIVE STATISTICAL SUMMARY OF RECREATIONAL BOAT USE QUESTIONNAIRE

Boat characteristics and boat facility demand by season and location were derived from a questionnaire survey of registered boatowners residing in Washington and northwest Oregon. Information was obtained on type of pleasure craft owned, multiple boat ownership, seasonal use, demand for moorage and launching ramp facilities, public shoreline park use, amount of boat damage incurred in 1978 and boating expenditures in 1978. A random sample of 2,500 boaters was drawn from the U.S. Coast Guard register and the Oregon State Marine Board boat register. Nearly 600 questionnaires (24 percent) were returned. After subtracting those respondents who no longer own a boat, a total of 439 questionnaires remained, which formed the sample size used in the statistical analysis.

Boat characteristics were requested for the largest boat, second largest boat and third largest boat. Statistical data on boat characteristics presented in this selective summary are for the largest boat or a total of 439 craft.

1. Approximately 40 percent of respondents were multiple boatowners; 33 percent owned two boats and 7 percent owned three boats.

2. Fifty-two percent of pleasure craft owners surveyed owned outboards, 26 percent owned inboard/outdrive, 12 percent owned inboards and sailboats account for the remaining 10 percent.

3. About 72 percent of pleasure boat hulls were composed of fiberglass, 14 percent wood, 13 percent aluminum and the remaining 1 percent of steel and other material.

4. Sixty-four percent of the boatowners surveyed normally trailered their boats.

5. Average length by type of pleasure boat was as follows:

Boat Type	Model Class (Feet)
Inboard	21-26
Inboard/Outdrive	16-20
Outboard	16-20
Sailboat	21-26

6. The age distribution of the pleasure craft surveyed was as follows:

Age	Percent of Total
1 year or less	6
2 years	6
3 years	11
4 years	6
5 years	8
6 to 10 years	32
11 to 25 years	29
26 years or older	2
TOTAL	100

7. The average cost of pleasure craft when acquired and the average current market value of these same boats, by type of boat, was as follows:

	Mean Values	
Boat Type	Cost When Acquired	Current Market Value
Inboard	$21,923	$29,891
Inboard/Outdrive	$7,860	$8,054
Outboard	$2,007	$1,634
Sailboat	$20,741	$25,300
For entire sample	$7,687	$9,397

8. Present moorage/storage use in the study area[1] for all boats surveyed is shown below:

Moorage/Storage Facility	Percent of Responses
Wet Enclosed	4
Wet Covered	11
Wet Open	34
Dry Covered	6
Dry Open	4
Home	40
Other	1
TOTAL	100

9. Desired future moorage/storage facilities in the study area[1] assuming space availability and current prices were as follows:

Moorage/Storage Facility	Percent of Responses
Wet Enclosed	8
Wet Covered	21
Wet Open	31
Dry Covered	11
Dry Open	1
Home	28
Other	-
TOTAL	100

10. The average number of days respondents operated their boats during 1978 within the study area is shown below by month:

Month	Mean Number of Boating Days in 1978
January	4.33
February	4.41
March	5.31
April	5.97
May	7.14
June	9.68
July	12.25
August	12.41
September	8.91
October	5.67
November	4.66
December	4.64

11. Nineteen percent of pleasure craft owners surveyed incurred damage to their boats in 1978. The most frequently given cause of damage was hitting logs or deadheads.

12. The number of people in a usual boating party in 1978 ranged from 1 to 22. The distribution of responses was as follows:

Number of People in Party	Percent of Responses
1	2
2	36
3	22
4	30
5	5
6	3
More than 6	2
TOTAL	100

13. The following tabulation shows the average boating related expenditures in the state of Washington during 1978:

Type of Expenditure	Mean Value
Insurance	$ 241
Permanent Moorage/Storage	528
Temporary Moorage/Storage	60
Transient Moorage/Storage	43
Launch and Ramp Fees	35
Fuel and Lubricants	229
Boating Accessories	356
Maintenance and Repair (Parts)	265
Maintenance and Repair (Labor)	299
Groceries and Beverages	212
Tools/Fees for Ferries, Campgrounds, etc.	57
Boating Related Automobile Expenses	187
Other Boating Expenses	154
TOTAL	$2,666

[1] Includes Washington saltwater shorelines, Lake Washington, Lake Union and the Washington shore of the Columbia River downriver from Bonneville Dam.

14. The distribution of total household income of all respondents was as follows:

Income Class	Percent of Respondents
$10,000 or less	7
$10,001 to $15,000	6
$15,001 to $20,000	12
$20,001 to $25,000	18
$25,001 to $30,000	15
$30,001 to $35,000	12
$35,001 to $40,000	9
$40,001 to $45,000	7
$45,001 or more	14
TOTAL	100